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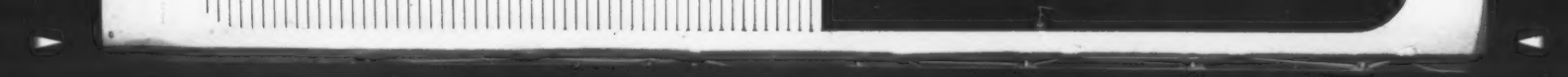

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J. B. WEBSTER, M.I.P.E.

Institution Personalities — 11.

J. B. WEBSTER, M.I.P.E.

J. B. WEBSTER, M.I.P.E.

Mr. J. B. Webster, President of the Eastern Counties Section of the Institution, is Works Manager of the well-known firm of Crane, Ltd., Ipswich. As one of the younger generation of engineers, he is a strong believer in encouraging progress in both the educational and technical fields.

He is keenly interested in technical education, and has served as a Governor of Ipswich School of Technology since 1941, being at present Deputy Chairman. A firm advocate of the Higher National Certificate in Production Engineering, he has supported Production Engineering Classes at the School of Technology.

Mr. Webster has spent some time in Canada and America, studying foundry and machine shop layouts, organisation, and production methods, and is of the opinion that the United Kingdom has still much to learn from America in the manufacture of mechanical handling equipment. As regards workmanship, however, he maintains that when similar articles are manufactured on both sides of the Atlantic, the British product is usually of superior quality.

During the Second World War, Mr. Webster held several honorary public offices, among them that of Deputy Chairman of Ipswich and District Mutual Aid Cutting Tools Committee for the Ministry of Supply, and was a member of Ipswich and Colchester Fuel Efficiency Committee of the Ministry of Fuel and Power. He was also a Company Commander of the 9th and 11th Battalions, Suffolk Home Guard, from its embodiment until it was disbanded, having previously held a commission in a Field Company Divisional Royal Engineers, Territorial Army.

Mr. Webster was educated at Jarrow County Secondary School and Sunderland Technical College, where he obtained the diploma of Associate of the Technical College in Mechanical Engineering. He served his apprenticeship in the engine works of Palmer's Shipbuildings and Iron Company, Jarrow-on-Tyne, passing into the Drawing Office during his final year.

He subsequently joined Babcock and Wilcox Ltd., as a draughtsman and later transferred to the International Combustion Company, Ltd., London, as Section Leader.

In 1930, he went to Crane, Ltd., as a draughtsman on plant layout, and was promoted successively to Chief Draughtsman, Plant Engineer, Assistant Works Manager and Works Manager. The latter appointment he holds at the present time.

Mr. Webster has rendered valuable and active service to the Institution since he became a member in 1932. In addition to holding office as President of the Eastern Counties Section since 1947, he was Section Honorary Secretary from 1935 to 1939, and has been a member of the Section Committee since 1939.

He is also Senior Vice-President of the Ipswich Engineering Society.

INSTITUTION NOTES

May, 1949

PRESENTATION TO MR. F. W. CRANMER

The February Meeting of the Manchester Section was preceded by a brief but pleasing ceremony, when a presentation was made to Mr. Frank W. Cranmer, M.I.P.E. to mark his retirement from the Honorary Secretaryship of the Manchester Section.

Mr. H. G. Gregory, M.I.P.E. Section President, in making the presentation of an electric clock and set of golf clubs, together with

Mr. H. G. Gregory making the presentation to Mr. Cranmer. (right)

a cheque, thanked Mr. Cranmer on behalf of the Institution and the Manchester Section for his sterling work during the many years of his term of office. Mr. Gregory outlined briefly the work involved in being Honorary Secretary of a large Section of the Institution, and stated that Manchester had indeed been fortunate in having a man whose first thought had always been, and still

was, to further the work of the Institution. Any prominence that the Manchester Section might have achieved had been largely due to the efforts and foresight of Mr. Cranmer.

Mr. F. Osborne, M.I.P.E., Section Vice-President, spoke in support of Mr. Gregory, and said that Mr. Cranmer could be looked upon as guide, philosopher and friend. They were very sorry to see him relinquish office, but it was good to know that he was remaining a member of the Section Committee, so they would still enjoy the benefit of his experience.

In response, Mr. Cranmer said he did not expect such a pleasant surprise. Mrs. Cranmer would no doubt find a place for the electric clock, and the golf clubs would provide him with many happy hours of recreation.

He had enjoyed his period of office, and whilst it called for hard work, it also provided compensation in the form of the many firm friendships he had made during this Secretaryship. Mr. Cranmer concluded by saying that he had always tried to carry out his duties quietly and sincerely, with the object of furthering the work of the Institution and the Manchester Section, and he would like to thank the Section Committee and members for the very fine presentation. He added that with the permission of those who contributed he would like to send the cheque to the Richard Hazleton Memorial Library Fund, as a donation in the name of the Manchester Section.

A sincere vote of thanks, with best wishes to Mr. and Mrs. Cranmer for the future, was passed with acclamation.

NATIONAL INDUSTRIAL SAFETY CONFERENCE

This year's National Industrial Safety Conference, organised as usual by the Royal Society for the Prevention of Accidents, will be held at Scarborough, May 13th to May 15th. Among the speakers will be Sir Charles Bartlett, M.I.P.E., Managing Director of Vauxhall Motors, Ltd., and a Vice-President of the Society, whose subject will be " A Managing Director's View of Industrial Safety."

Full particulars and application forms may be obtained from the Industrial Safety Division of RoSPA, 131, Sloane Street, London, S.W.1.

TECHNICAL EDUCATION

The Governors of the Wolverhampton & Staffordshire Technical College invite applications for the appointment of full-time teacher for work mainly in connection with the Ordinary National Certificate in Mechanical Engineering and the Higher National Certificate in Production Engineering. Salary will be in accordance with the Burnham scale, with additions for degree and recognised training; the commencing salary will be

determined by teaching and/or industrial experience. Further particulars may be obtained from the Clerk to the Governors, Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton.

SECTION QUARTERLY REPORTS We have been advised by the South African Branch that in their quarterly report published in the December, 1948, issue, the address on "Inspection and Quality Control" was erroneously reported as having been given by Dr. Rowe. The lecture was actually given by Dr. F. A. H. de Beer.

BRITISH STANDARDS INSTITUTION The undermentioned draft B.S. Specification is now available for comment :

CK(MEE)1095—Third Draft British Standard for Guards for Coupling and Associated Shafting. Latest date for receipt of comments : 16.6.49.

This draft has been prepared by B.S.I. Committee MEE/5—Coupling Guards, on which the Institution is represented by Mr. G. W. Clarke, M.I.P.E. Copies can be obtained gratis from the British Standards Institution, provided that mention is made in the letter of application that the writer is a member of the Institution of Production Engineers.

The following Standard has recently been issued and is obtainable from the British Standards Institution, 28, Victoria Street, Westminster, S.W.1, price 2s. post free :

1542 : 1949—Equipment for eye and face protection during welding.

I.P.E. Representative on appropriate B.S.I. Committee : Mr. F. Southwell, M.I.P.E.

BOOKS RECEIVED "Technical Metalcraft for Schools" by J. R Ferguson, M.Coll.H., B.T. Batsford, Ltd., London. Price 7/6d. net.

This book, which is well produced, should prove useful in the development of technical metalwork courses of a junior grade, and a number of the projects will certainly satisfy more advanced courses and warrant an expansion of the first part of the book to ensure adequate explanation of the basic principles. It should be clearly understood that the approach is with reference to school workshops rather than to industry. T.B.W., M.I.P.E.

"Jigs, Tools and Fixtures" by Philip Gates. The Technical Press, Ltd., Surrey. Price 17/6d. net.

" Quality Control " by N. L. Enrick. The Industrial Press, New York (Distributors : Machinery Publishing Co., Ltd., Brighton). Price 21/- net.

" Careers in Engineering." Powers-Samas Accounting Machines, Ltd., London.

NEWS OF MEMBERS

Mr. E. H. Banister, Int.A.M.I.P.E., has been transferred from the Royal Ordnance Factory, Radway Green, to the Royal Arsenal, Woolwich.

Mr. Alan Browne, A.M.I.P.E., is now Works Manager of B.S.A. Tools, Ltd., Marston Green, Birmingham.

Mr. G. A. Grantham, A.M.I.P.E., is now Chief Engineer of Weddell Tools, Inc., of New York.

Mr. T. C. Greenhalgh, A.M.I.P.E. has left the United Kingdom to take up a position as General Manager of Chaseside Engineering Co., Ltd., Toronto.

Mr. A. G. Harling, A.M.I.P.E., is now Works Manager of F.N.F., Ltd., Textile Engineers of Burton-on-Trent.

Mr. L. R. Houghton, Int.A.M.I.P.E., is now Production Engineer to the Coalville Branch of Cascelloid, Ltd.

Mr. R. R. Kenderdine, A.M.I.P.E., has joined Crompton Parkinson, Ltd., Chelmsford, as Chief Production Engineer.

Mr. Allan Moncrieff, O.B.E., M.C., M.A., M.I.P.E., A.M.I.C.E., who was for some time a member of Council, being President of the Sheffield Section, has recently been appointed Divisional Manager Factories with the Colonial Development Corporation. He will handle a wide variety of manufacturing and processing schemes in the Colonies, and his functions will include the supervision of plans for, and the construction of, plants, and he will be responsible for the commercial health of undertakings in operation.

Mr. Ralph Parish, A.M.I.P.E., M.I.W.M., A.M.I.I.A., will be in England on leave from the Gold Coast from May to August this year. During his stay he will be attached to the Yorkshire Section.

Mr. Mansergh Shaw, A.M.I.P.E., has resigned his appointment as Tube Investments' Research Fellow in the Department of Engineering Production of the University of Birmingham, on his appointment as Professor of Mechanical Engineering in the University of Queensland, Australia. He would like to thank all those members of the Institution who helped to make his stay in this country so pleasant and so informative, and to express his appreciation of their kindness to him.

Mr. John Silcock, Int.A.M.I.P.E., is now Chief Draughtsman with Messey Harris, Ltd., Manchester.

Mr. P. J. Swales, A.I.P.E., is now Export Sales Director of The Sheffield Corporation of Dayton, Ohio, U.S.A.

Mr. L. C. Row, M.I.P.E., M.I.Mech.E., Director of Rhodes, Brydon & Youatt, Ltd., Stockport, will be visiting the Canadian International Exhibition, Toronto, and will also spend some time in the United States.

Mr. C. Toeman, Int.A.M.I.P.E., was recently appointed General Manager of Hudes Merchandising Corporation, Ltd., London.

Mr. S. A. Warwick, A.M.I.P.E., is now Chief Draughtsman and Planning Engineer at De Grave Short & Co., Ltd., London.

Mr. Edward A. Young, A.M.I.P.E., has been elected President of the National Appraisal Co. of Canada, Ltd.

EASTERN COUNTIES SECTION Eastern Counties Section regret to report the resignation from the Committee of Mr. A. E. Newby, M.B.E., M.I.P.E., owing to ill-health. Mr. Newby is a Past President of the Section, and for many years has been a member of the Committee. Well-known in engineering circles, Mr. Newby is this year's President of the Ipswich Engineering Society. His many friends, including the members of the Section, will wish him a happy recovery to good health.

OBITUARY The Institution deeply regrets to announce the deaths of the following members: Mr. George L. Campbell, A.M.I.P.E., of Glasgow Section; Mr. W. H. Fidler, M.I.P.E., of Sheffield Section. Mr. Fidler was one of the founder members of the Sheffield Section and for a short time acted as Hon. Secretary.

ISSUE OF JOURNAL TO NEW MEMBERS Owing to the fact that output has to be adjusted to meet requirements, and in order to avoid carrying heavy stocks, it has been decided that the Journal will only be issued to new Members from the date they join the Institution.

IMPORTANT In order that the Journal may be despatched on time, it is essential that copy should reach the Head Office of the Institution not later than 40 days prior to the date of issue, which is the first of each month.

SECTION MEETINGS

The following meetings have been arranged to take place in May and June, 1949. Where full details are not given, these have not been received at the time of going to press.

May

4th NOTTINGHAM SECTION. The Presidential Address will be given by Mr. J. H. Bingham, M.I.P.E.

May—*cont.*

4th WOLVERHAMPTON SECTION. A lecture on "Locks" will be given by Mr. H. G. Ramsell, M.I.P.E., M.I.Mech.E., at the Willenhall Evening Institute.

10th WOLVERHAMPTON GRADUATE SECTION. A lecture on "Electro-static Spraying" will be given by Mr. J. Stribley and Mr. W. H. Cockerill, A.M.I.P.E., A.M.I.Mech.E., at Wisemore School, Walsall, at 7-15 p.m.

19th LONDON SECTION. A lecture on "Modern Aspects of Centreless Grinding" will be given by Mr. A. Scrivener, M.C., M.Inst.B.E. The Institution Awards for 1948 will be presented by the President, Dr. H. Schofield, C.B.E., immediately prior to the lecture.

28th LEICESTER SECTION. A conducted tour of the Waterworks at Cropston, Leicester, has been arranged.

June

11th LEICESTER SECTION. A second tour of the Waterworks at Cropston, Leicester, has been arranged.

14th WOLVERHAMPTON GRADUATE SECTION. A lecture on "Aluminium Alloys and their Fabrication," illustrated by a film, will be presented by the Aluminium Development Association at the Wolverhampton and Staffordshire Technical College at 7-15 p.m.

SECTION ACTIVITIES

BIRMINGHAM This Section has had a full programme of lecture meetings and social functions. The Section record attendance at a lecture on a technical subject was reached on March 16th, when Mr. A. Scrivener, M.C., M.Inst.B.E., read his paper on "Modern Centreless Grinding." Some three hundred members and friends were present at the Buffet Dance at the Botanical Gardens on February 19th, and the Annual Dinner Dance on March 26th was thoroughly enjoyed by all those present.

BIRMINGHAM GRADUATE The January discussion meeting was well received and amply repaid the Committee's efforts in arranging this meeting. In February, Mr. P. Spear, B.Eng., Grad.I.P.E., gave an excellent lecture on "Fine Finishing," and many noteworthy points were raised in the ensuing discussion. Attendances at lectures have increased, but there is still room for improvement.

CALCUTTA In January the Section held its first works visit, which proved a great success. The works of The Calcutta Port Commissioners were visited by kind permission of the Chief Mechanical Engineer, Mr. Moffat, and his Assistant, Mr. Glegg, A.M.I.P.E. In February the second works visit took place to the Jay Engineering Works, by kind permission of Dr. T. R. Gupta, M.I.P.E. Several interesting lectures have been given, and membership is still on the increase.

DERBY SUB-SECTION The Education Officer, Mr. T. B. Worth, M.I.P.E., A.M.I.Mech.E., A.M.I.E.E., took advantage of his visit to Derby on February 21st–23rd to contact leading industrialists and educationalists in the area. He was accompanied on his tour by the Sub-Section Chairman, Mr. G. Harrison, M.I.P.E.

EASTERN COUNTIES In January a most interesting talk on "Air Operated Fixtures" was given by Mr. M. P. Watts, when a wide variety of pneumatically controlled jigs and tools was demonstrated. At the discussion on the Institution's common subject, "The Position of the Production Engineer in Relation to the National Economy," the Works Managers of four local engineering concerns agreed to read short papers. These were followed by an interesting and informative discussion. In March, Mr. B. B. Beaumont gave a lecture on "Budgetary Control" in which he dealt with the basic principles of this subject, and demonstrated his scheme with clearly defined illustrations. Many accountants from local concerns attended this meeting.

EDINBURGH In February the Chairman of Council, Mr. J. E. Hill, M.I.P.E., attended a meeting in Dundee at which it was decided to ask Council to agree to the formation of a Dundee Section. The Section Committee are particularly grateful to Mr. Hill for his interest in this matter, especially as it necessitated a long journey at considerable personal inconvenience. The three-day visit of the Education Officer, Mr. T. B. Worth, M.I.P.E., A.M.I.Mech.E., A.M.I.E.E., in February was thoroughly appreciated. After reading his paper "The Education of the Production Engineer" to the Section, Mr. Worth also paid a visit to the University College, Dundee, and gave his paper to a Joint Meeting arranged by the Dundee Institute of Engineers. On this occasion the Chair was occupied by Dr. Whittaker, Principal of the Dundee Institute of Art and Technology. The March lecture had to be changed at short notice owing to Mr. F. T. Barwell's visit to America, but Mr. E. C. Gordon England, M.I.P.E., very kindly gave his paper on "Valid Incentives." On this occasion the Section was honoured by a visit from Sir Robert McLean, B.Sc., M.I.P.E., F.R.Ae.S., a former President of the Institution.

GLASGOW The informal meeting recently held in the Royal Technical College, Glasgow, in order to study the facilities offered by the College for the training and education of production engineers was very well attended. Although such facilities have been somewhat neglected in Glasgow in the past, the Section members are now confident that the provision made is equal to any in the country. The number of new applications being received is considerably greater than in previous years, and it is anticipated that by the end of the session the membership will be over 200.

HALIFAX A good attendance at lectures has been maintained in the last three months, and the Section now has a membership of 202. The next programme for 1949/50 is very nearly completed and will cover a wide range of subjects. It is also hoped to arrange a number of works' visits during the Spring months.

LIVERPOOL During this quarter the Section has enjoyed some excellent lectures, including "Metals in the Service of Man" by Dr. Alexander, "Education for Management," by Lieutenant-Colonel Urwick, and "Difficulties and Developments in Deep Drawing and Pressing" by Dr. J. D. Jevons. Membership of the Section continues to increase, the present strength being 140.

LONDON A most successful lecture meeting was held jointly with the British Institute of Radio Engineers on February 17th, the subject being "Electronic Equipment for the Production Engineer." Two papers were given, "Development of Electronic Equipment" by J. L. Thompson, M.Brit.I.R.E., followed by "Electronic Control of Machine Tools" by S. A. Ghalib, B.Sc. Lieutenant-Colonel Urwick's paper on "Management's Debt to Engineering" was also very well received, but attendance on works' visits has been disappointing.

LUTON GRADUATE The programme this session was based on the theme of "Chipless Forming" and has proved to be even more successful than the previous session. Attendances have indicated that film shows are most popular, followed by visits and illustrated lectures, with little to choose between them. The lecture with no illustrations has been found to have the lowest appeal, and therefore none has been held. The Annual General Meeting took place on April 6th, combined with the Graduates' Evening.

MANCHESTER The new year opened with a very fine talk by the Education Officer, Mr. T. B. Worth, M.I.P.E., A.M.I. Mech.E., A.M.I.E.E., on "The Education of the Production Engineer" which was received by a large and appreciative audience.

Mr. Worth also gave his lecture at Crewe. The February Meeting was preceded by a presentation to Mr. F. W. Cranmer, M.I.P.E., to mark his retirement as Section Honorary Secretary. Visits have been made to the Oil Well Engineering Company Limited, Stockport, and The Manchester Oil Refinery Company Limited. Members who attended were most appreciative of the facilities and hospitality afforded by both firms.

MELBOURNE A most interesting lecture was given in March by the Vice-President of the Section, Colonel F. G. Thorpe, M.I.P.E., formerly Commonwealth Director for Machine Tools and Gauges, who had recently returned from a visit to the United Kingdom. Colonel Thorpe's address, "Recent Developments in Machine Tools" was based on his observations at the British Machine Tool Exhibition.

NORTH-EASTERN GRADUATE On December 17th, 1948 the Section held its annual film evening. A meeting which was arranged jointly with the local Graduate Section of the Institution of Mechanical Engineers was extremely successful and attracted a large audience. The talk on "Management" by the President of the Senior Section, Mr. A. Bowron, M.I.P.E., M.I.Mech.E., given on January 21st, 1949, was most instructive and greatly appreciated. The Section Committee has already arranged a provisional programme for the coming session.

SHEFFIELD In addition to the normal lecture meetings, three informal discussion meetings have been held at monthly intervals, the discussions ranging over a very wide field. Members report that information exchanged at these meetings proves to be of considerable value, as in most cases it is related to definite problems.

SOUTH AFRICA A large audience attended the February meeting which took the form of a film evening. The main feature was a film entitled "The Wheels behind the Wheels" and a supporting programme of six films, lasting nearly two hours, was provided. This was, perhaps, the most comprehensive programme yet presented to the Branch. A Problems and Discussion Evening was held in March, and a large party of members and guests took part in a visit to the South African Mint in Pretoria, and the South African Bureau of Standards, at the end of the month.

SOUTH WALES & MONMOUTHSHIRE A keen interest in this Section is being shown by the executives of many large factories now established in the area, and many requests have been received for invitations to future lecture meetings. However, there

are still too few established light industries in the area, and it is hoped that appeals now being made by various organisations and local authorities will encourage established companies to occupy some of the factories now being built. There is little doubt that in works already established, where efficient production engineering technique is employed, local labour is giving results comparable with any other development area.

SYDNEY In March a visit was paid to the works of The Australian Aluminium Company Limited, when 35 members were escorted through the plant. The members were afterwards entertained to afternoon tea and then viewed two short films dealing with the aluminium industry. These were extremely interesting and conveyed to members a very realistic picture of this particular industry. The Section has also enjoyed two excellent papers "Human Engineering in Industry" by Mr. C. M. Kennedy, A.M.I.P.E., and "Manufacture of Woodworking Machinery" by Mr. N. L. Eaton, A.M.I.P.E.

WESTERN During the first quarter of the year the Section has had seven lectures, of which four have been in the outlying districts covering Swindon, Gloucester, Stroud and Exeter. All the lectures were exceptionally well attended and received. The Committee has already commenced preparations for the 1949/50 programme and it is hoped to maintain the standard already achieved.

YORKSHIRE In addition to three successful lecture meetings and the Annual General Meeting on March 7th, the Section held its annual dinner at the Hotel Metropole, Leeds, on March 19th. Many distinguished guests were present, among them Canon A. S. Reeve, M.A., Vicar of Leeds, the Presidents of the Manchester and Halifax Sections, the Education Officer, Mr. T. B. Worth, M.I.P.E., A.M.I.Mech.E., A.M.I.E.E., and the Director and General Secretary, Major C. B. Thorne, M.C.

THE EDUCATION OF THE PRODUCTION ENGINEER

by T. B. WORTH,
M.I.P.E., A.M.I.Mech.E., A.M.I.E.E.
Education Officer to the Institution.

Presented at the Royal Empire Society, London, on 9th September, 1948, and since to the following Sections and Sub-Sections:

Eastern Counties	...	*October, 1948*
Glasgow	...	*November, 1948*
North Eastern	...	*November, 1948 (by Deputy)*
Yorkshire	...	*December, 1948 (by Deputy)*
Western	...	*January, 1949*
Manchester (and Crewe)	...	*January, 1949*
Edinburgh	...	*February, 1949*
Derby	...	*February, 1949*
Birmingham	...	*April, 1949*

Before presenting the paper, I wish to stress that no attempt is made to define education except in the sense that it embraces all those experiences in the educational field, as distinct from training, which promote the development of production engineering knowledge. It is realised also, that there are a number of avenues by which a Production Engineer might reach proficiency—hence the need for a balanced approach.

Throughout the history of the engineering profession, there has always been a body of engineers whose prime responsibility in all types and sizes of organisation was to plan and direct the application of productive effort. Their duties, although in the past not always clearly defined, are today recognised as essential to economic enterprise and careers in production engineering have become of major importance, not only professionally but nationally. Recognition of a planned and progressive technical education directed towards encouraging appreciation of the problems encountered in production, as distinct from design, is of sufficient volume and establishment to warrant a review of the past and anticipation of the future.

During the past ten years, an increased educational awareness coupled with the recognition that our economy is governed by the efficiency with which a somewhat limited manpower is used, has resulted in a considerable expression of ideas as to the most efficient form of engineering training and education. It is essential that such expression should be continuous and tempered by changes in technology emanating from a rapidly expanding body of scientific

knowledge, and such a basic subject as engineering education and training is vital, since developments in technology invariably require engineering as the medium for translation from scientific thought to productive achievement. There will be, however, throughout this rapid and often revolutionary expansion a fundamental educational pattern, and it is this I wish to attempt to delineate and expand, and to show present practice and, most important, evaluate future demands. Education may be interpreted within boundaries of considerable elasticity, but in its broadest sense it is the main function of this Institution which, by constitution and procedure, is an educational medium which embraces the whole profession in the major fields of Technology and Management. Reports such as that on Higher Technological Education (1944), known as the Percy Report, and Education for Management (1947), known as the Urwick Report, are not only indicative of the intense and careful thoughts given to this subject, but are of vital importance as specifically embracing the two subjects which are the concern of this Institution. Again, at the inaugural meeting of the National Advisory Council on Education for Industry and Commerce, its immediate attention was directed by the Minister of Education to just those subjects—Higher Technology and Management.

The wealth of published material which has resulted from this awareness and desire to define the most efficient educational schemes, makes it difficult to devise a sufficiently distinctive title for this paper, and in using the sub-title, " A Critical Survey," I would define critical as " judging of merit " (O.E.D.).

The purpose of this paper then, is to present a survey in which production engineering education is defined and analysed and which will serve as an industrial and educational reference. It is hoped that it will encourage thought and suggestion, and by stating what has been done it will, in the true research style, promote future development.

The specific objects are :—

(1) To determine an acceptable pattern for education for production in a wide sense.

(2) To define the place of production engineering education in the general scheme of technical education.

(3) To show the history of development and in so doing, to indicate the extent to which facilities are used or are lacking, and (most important)

(4) By careful analysis and discussion to anticipate the needs of the future.

EDUCATIONAL PATTERN FOR PRODUCTION

It would be unwise to embark upon any analysis or to attempt to define a pattern without exploratory thought, which leads to the initial conclusion that the considerable diversity of careers in the engineering industry makes it highly improbable that a single scheme of technical education and training can satisfy all the demands the profession is likely to make. There is, however, no doubt that the needs of the Production Engineer are well defined and embrace knowledge which may be termed "material" and, equally important, "human." Thus, by concentrating its corporate energy in this well defined field, this Institution is likely to achieve a higher degree of efficiency in its scheme of education for technology and management than would be possible by dissipation of effort in an attempt to embrace education for the whole profession of engineering.

The Production Engineer must be able to appreciate quality and to recognise standards, whether they be standards of measurement, of performance, or standards of behaviour. His education, therefore, involves principles which have universal appeal and application, and which often combine human and material content, as is evident from such terms or units as Production per Man-Hour. It is instructive to note that the first industrial revolution—characterised as technical—imposed strains on the educational system of the time, just as the present industrial revolution in the field of human relations imposes today. The following passage from "Ideas and Beliefs of the Victorians" (The Listener) refers to the changed outlook of the times and contains much that may be applied to the problems of today:

"The change from individualism to collectivism was not, of course, a change made by doctrinaire philosophers sitting in academic ivory towers, remote from reality.

"The changing relations of the complex production system, the new technologies which the discoveries of science made possible, have made the major contribution to the change. What philosophers like T. H. Green or the men of letters like Ruskin did, was to provide the basis for understanding the necessity for the change. They prepared men to receive it. An illiterate Britain, to take an obvious example, could not have become the "Workshop of the World." Its craftsmen, in every skilled occupation, needed the knowledge of reading and writing if production was to utilise successfully the resources at its disposal. The philosophers of collectivism made the needs of their time seem principles which were intellectually convincing and emotionally satisfying."

Therein lies the general pattern of education for the Production Engineer, and our duty to those who will have, or who already have, the responsibility of initiating and directing production and who

must achieve a successful marriage of technology and management, is to enable them to experience educational processes which will give them the ability to use the available resources for production and, at the same time, to feel intellectually convinced and emotionally satisfied.

The first frame in the pattern is literacy, and in our pursuit of technology and scientific management we must remember that the written and spoken word, the ability to transmit knowledge and ideas, are the most powerful tools in our productive tool-box. It should be our deep concern that the standard in such matters is not high, and that the technician often merits criticism in this respect. Here again, the potentialities of the Institution in this aspect of education are immense, as it provides the necessary platforms for self-expression and interchange of ideas. The general educational pattern, of particular importance to the Production Engineer, but having the essence of universality is: LITERACY + FUNDAMENTAL SCIENCE + TECHNOLOGY + MANAGEMENT. It may be represented by a simple educational triangle as in Fig. 1, and the arrows, like Janus, look both forward and backward. It is accidental that in the accepted notation for the analysis of structures, they also indicate compression, which is too often a characteristic of educational schemes today.

This leads to an analysis of schemes of Technical Education which of all forms of Higher Education is most closely linked with industry in production engineering, involving as it does the co-ordination of all the factors, both material and human, concerned with production so that the most efficient overall combination is achieved. It is also important to realise that "technical" implies the combination of creative art, science and *economy in execution*—an implication which needs no emphasis from me today.

ANALYSIS OF TECHNICAL EDUCATION FOR ENGINEERING

Academic attainment for entry into the engineering profession is gained via two main avenues—the Universities and the Technical Colleges. The major contribution to production engineering education has been made by the Technical Colleges, and although there has been a considerable extension of production engineering research in the Universities and an awareness that such research is of vital importance in the development of technology for production, it is convenient to defer consideration of the part Universities can play in the scheme.

This analysis then deals with those courses operated in the major Technical Colleges, and Fig. 2 presents the general scheme of courses of the National Certificate type, which are typically British in conception and which, with the extension of part-time day release, will continue their important contribution in the future. Although

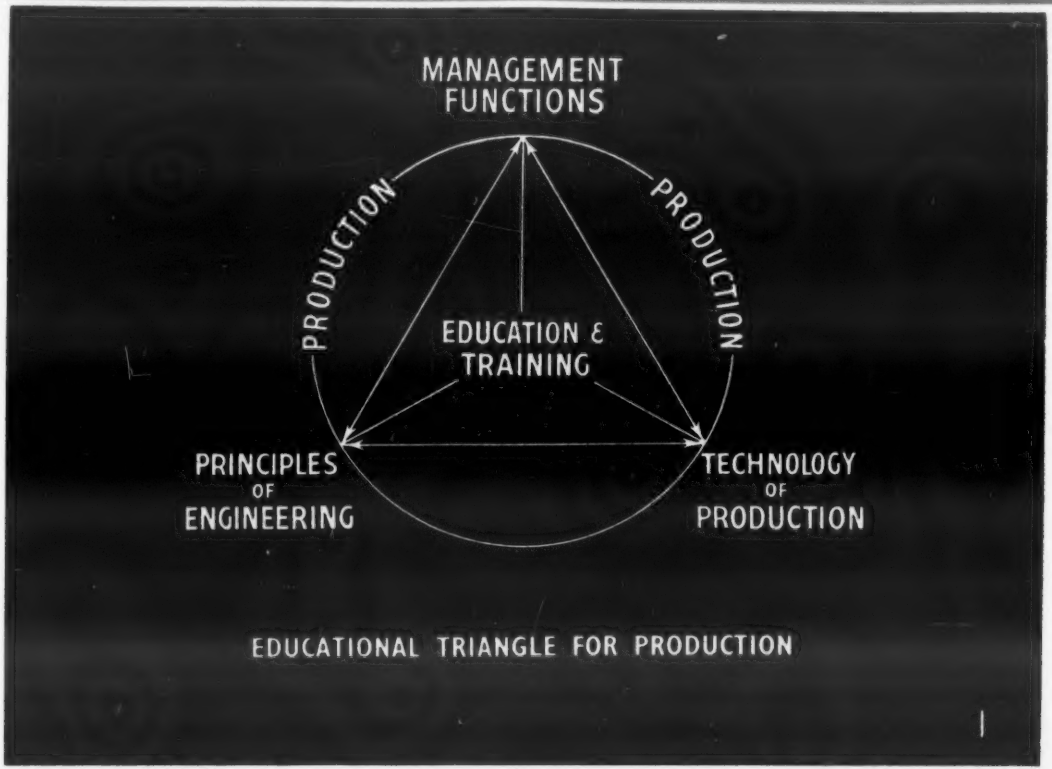
MANAGEMENT
FUNCTIONS
PRODUCTION
PRODUCTION
EDUCATION &
TRAINING
PRINCIPLES
OF
ENGINEERING
TECHNOLOGY
OF
PRODUCTION
EDUCATIONAL TRIANGLE FOR PRODUCTION

FIG. 1.

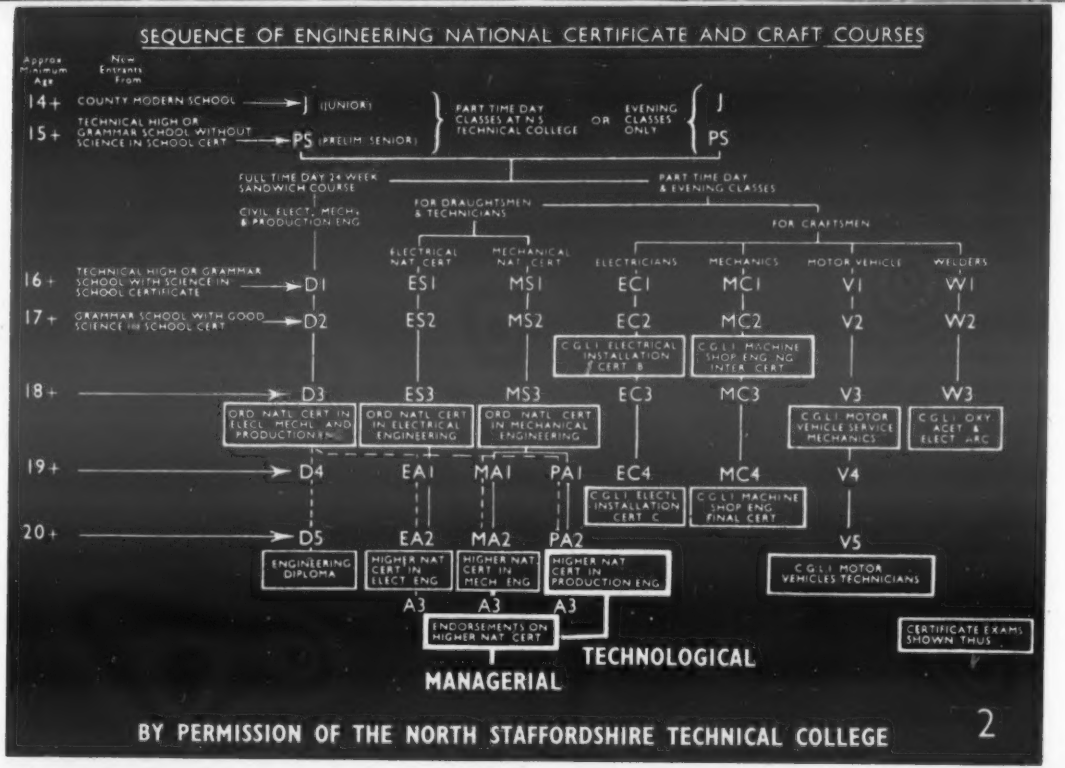
SEQUENCE OF ENGINEERING NATIONAL CERTIFICATE AND CRAFT COURSES
Approx Minimum Age
New Entrants From
14+ COUNTY MODERN SCHOOL → J (JUNIOR)
15+ TECHNICAL HIGH OR GRAMMAR SCHOOL WITHOUT SCIENCE IN SCHOOL CERT → PS (PRELIM SENIOR)
PART TIME DAY CLASSES AT N'S TECHNICAL COLLEGE
OR
EVENING CLASSES ONLY
J
PS
FULL TIME DAY 24 WEEK SANDWICH COURSE
PART TIME DAY & EVENING CLASSES
CIVIL, ELECT., MECH'L & PRODUCTION ENG
FOR DRAUGHTSMEN & TECHNICIANS
FOR CRAFTSMEN
ELECTRICAL NAT. CERT
MECHANICAL NAT. CERT
ELECTRICIANS
MECHANICS
MOTOR VEHICLE
WELDERS
16+ TECHNICAL HIGH OR GRAMMAR SCHOOL WITH SCIENCE IN SCHOOL CERTIFICATE → D1 ES1 MS1 EC1 MC1 V1 W1
17+ GRAMMAR SCHOOL WITH GOOD SCIENCE IN SCHOOL CERT → D2 ES2 MS2 EC2 MC2 V2 W2
C.G.L.I. ELECTRICAL INSTALLATION CERT B
C.G.L.I. MACHINE SHOP ENG'NG INTER CERT
18+ → D3 ES3 MS3 EC3 MC3 V3 W3
ORD. NATL. CERT IN ELECL. MECHL. AND PRODUCTION ENG.
ORD. NATL. CERT IN ELECTRICAL ENGINEERING
ORD. NATL. CERT IN MECHANICAL ENGINEERING
C.G.L.I. MOTOR VEHICLE SERVICE MECHANICS
C.G.L.I. OXY ACET & ELECT ARC
19+ → D4 EA1 MA1 PA1 EC4 MC4 V4
C.G.L.I. ELECTL INSTALLATION CERT C
C.G.L.I. MACHINE SHOP ENG. FINAL CERT
20+ → D5 EA2 MA2 PA2 V5
ENGINEERING DIPLOMA
HIGHER NAT. CERT IN ELECT. ENG
HIGHER NAT. CERT IN MECH. ENG
HIGHER NAT. CERT IN PRODUCTION ENG
C.G.L.I. MOTOR VEHICLES TECHNICIANS
A3 A3 A3
ENDORSEMENTS ON HIGHER NAT. CERT
CERTIFICATE EXAMS SHOWN THUS
TECHNOLOGICAL
MANAGERIAL
BY PERMISSION OF THE NORTH STAFFORDSHIRE TECHNICAL COLLEGE
2

FIG. 2.

their characteristics are well-known, it will be convenient to summarise the main conditions under which they operate. National Certificate Courses usually involve part-time day release from industry, thus preserving a balance of academic and practical progress which I think offsets, to a considerable extent, the inherent lack of continuity. Recent statistics of the Ministry of Education show an expansion of part-time day release but it has, even now, often to be solicited. It is only by co-operation from industry that technical education can enjoy a full measure of success. The associated examinations are internally set and externally assessed, which ensures equality of standard and allows the individual examinations to be related to some extent to subjects of importance to local industry—a valuable aspect and one that avoids wastage of manpower.

Similar conditions apply to courses leading to a National Diploma, except that full-time attendance at the College is required for three or four years, and this may be satisfied in two ways. The student may be associated with industry and may devote six months of the year to technical studies and six months to industry. Alternatively, students may take the Diploma Course as direct continuative education following their secondary education. Unless the latter conditions embrace practical training in the vacations and considerable liaison with industry through works' visits, the students are likely, in my experience, to encounter considerable difficulty in relating the fundamentals of production engineering to actual practice and will lack the balance which is so vital to production engineering.

Careful distinction should be made between National Certificate Courses and Trade Courses, in which the qualification is that of the City and Guilds of London Institute. Such qualification is the hall-mark of good craftsmanship and its importance today cannot be over-estimated, but the courses are non-professional and give little exemption from the examinations of professional engineering institutions. In my recent experience, such distinction is not always apparent and the title " Production Engineering Course " should be reserved for those courses leading to professional status. This lack of distinction, which occurs both in educational and industrial circles, is probably due to lack of appreciation of the method of approach in the respective courses, which is analytical and experimental in the professional courses and operational and more descriptive in the trade courses. To use an American term, the proportion of " know-why " to " know-how " is much greater in the professional courses.

It is evident from Fig. 2 that the Higher National Certificate scheme in Production Engineering forms one of the main engineering arteries leading to a major qualification of degree

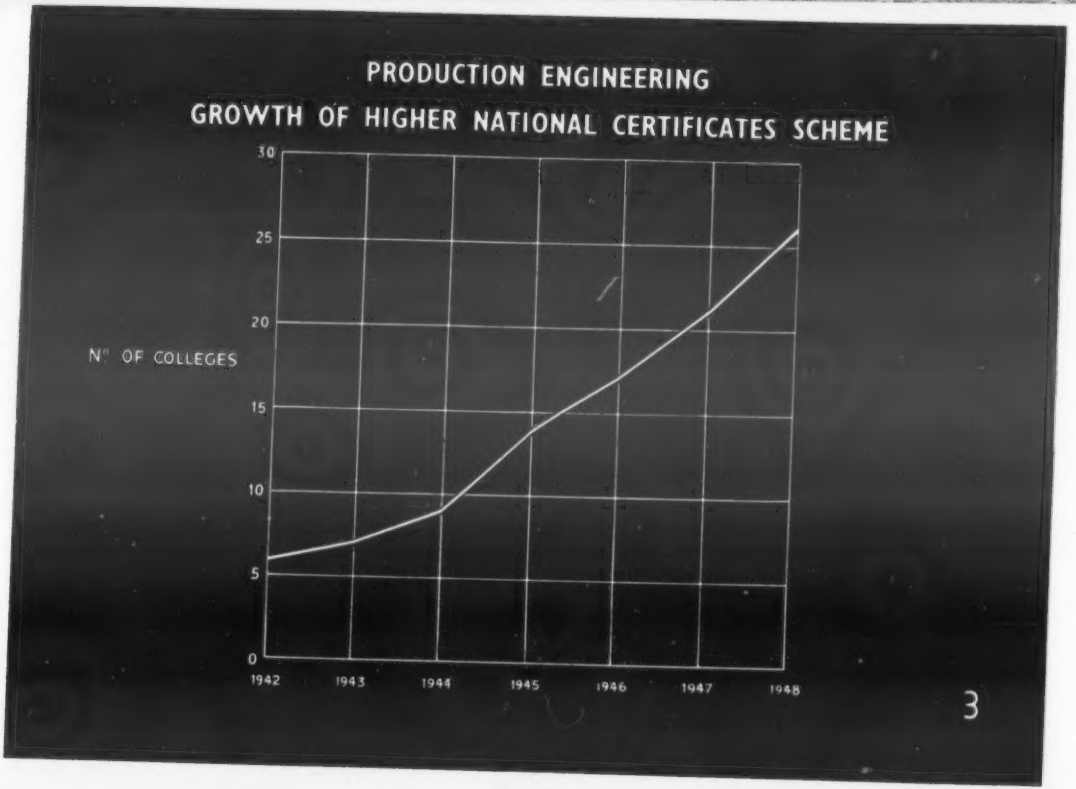
PRODUCTION ENGINEERING
GROWTH OF HIGHER NATIONAL CERTIFICATES SCHEME
N° OF COLLEGES
30
25
20
15
10
5
0
1942
1943
1944
1945
1946
1947
1948
3

FIG. 3.

standard in certain subjects. Such courses, at the instigation of the Institution of Production Engineers, were developed in partnership with the Ministry of Education and are of comparatively recent introduction. Their need became apparent when rapid and revolutionary developments in technology of production demanded an educational pattern not then satisfied by other courses either in content or method of approach.

GROWTH OF SCHEME IN PRODUCTION ENGINEERING

Fig. 3 shows the growth of the Higher National Certificate Scheme in Production Engineering which is operated by 27 major Technical Colleges throughout this country. Later I will illustrate their distribution with respect to industry. As shown in Fig. 2, there is no *ordinary* national certificate stage in production engineering, the standard of entry to the study of the subject being that of the Ordinary National Certificate in general engineering subjects of a fundamental scientific character with Workshop Technology as a main subject or endorsed. I do not think the inclusion of such an important production subject as Workshop Technology in the third year of the ordinary course, that is, the examination year, is fundamentally sound, and I would prefer it to be introduced in the second year, thus allowing two years of study of the subject. This is done in some courses, but too often it is given scant attention and a really sound basis for subsequent studies in production engineering is lacking.

Fig. 4 shows the growth in terms of student numbers and indicates the percentage passes, whilst Fig. 5 gives similar information concerning the Graduateship Examination of the Institution. A few comments concerning numbers will not be out of place here.

By its very nature, production engineering is highly selective and demands qualities difficult of measurement. It involves a study of the science of engineering and management applied to production and the number of students in production engineering courses will always be relatively fewer than in general engineering courses, and since they are responsible for the " work of others," their standard should be correspondingly high. Nevertheless, Figs. 3 and 4 should arouse concern and determination as it is obvious that, even allowing for the relatively fewer students, the available facilities are not being used to the full. The average number of students per college is about eleven, and over the whole of the country, a total of 300, with reference to 1947. Thus, although the scheme shows a healthy upward trend and a considerable number of colleges are in process of developing courses, there is a need for re-assessment by industry of the relative value of courses *with respect to the opportunities of their engineering apprentices*. Where these are likely to be found in those sections of an organisation which embrace production or

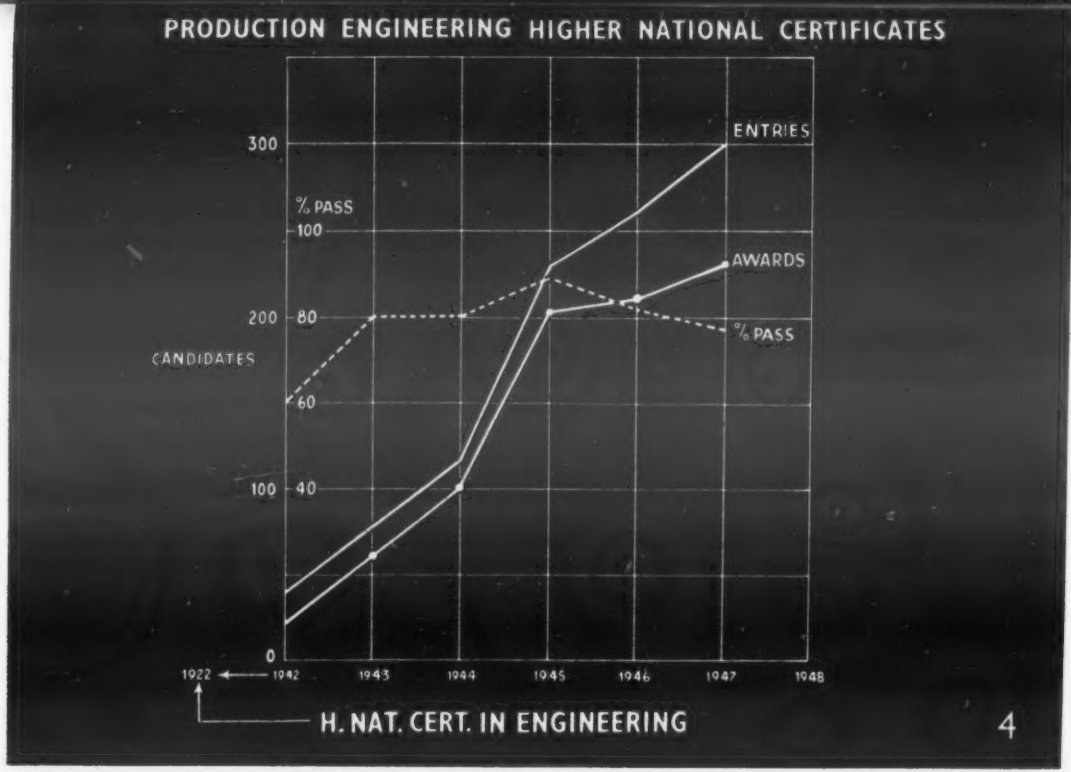
INSTITUTION OF PRODUCTION ENGINEERS GRADUATESHIP EXAMINATION
PRODUCTION ENGINEERING HIGHER NATIONAL CERTIFICATES
ENTRIES
AWARDS
% PASS
% PASS
CANDIDATES
300
200
100
0
100
80
60
40
1922
1942
1943
1944
1945
1946
1947
1948
H. NAT. CERT. IN ENGINEERING
4

FIG. 4.

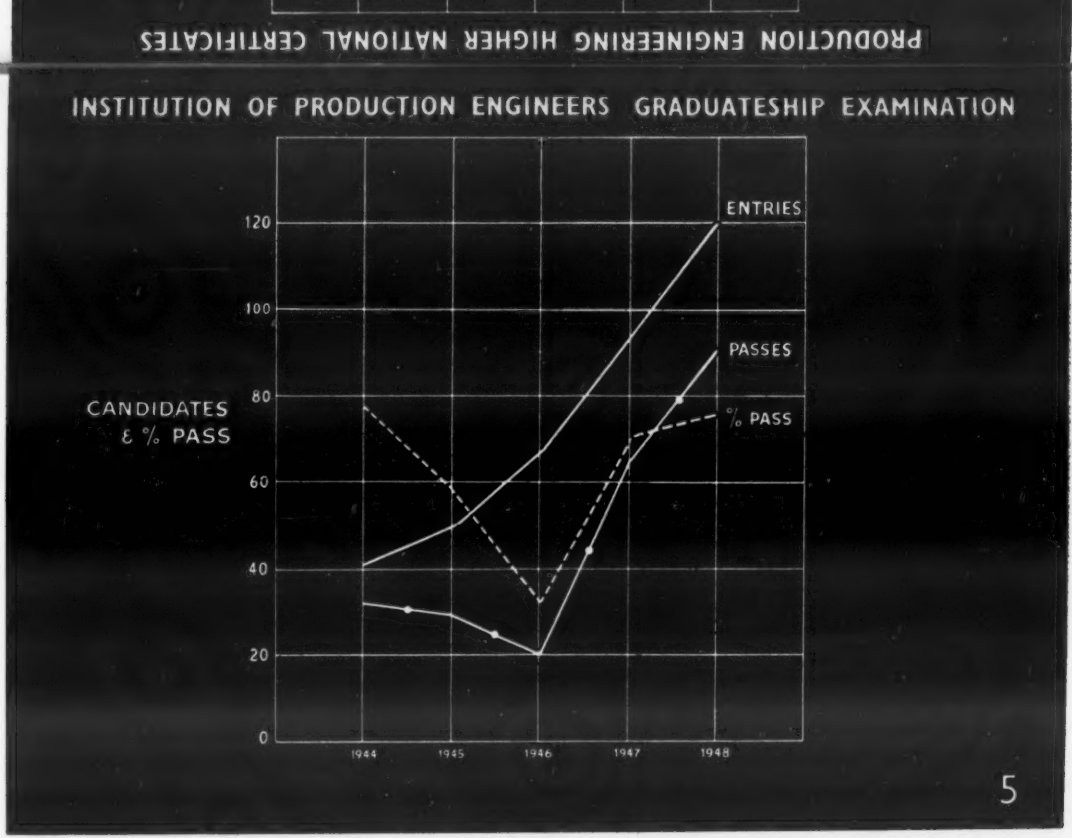
PRODUCTION ENGINEERING HIGHER NATIONAL CERTIFICATES
INSTITUTION OF PRODUCTION ENGINEERS GRADUATESHIP EXAMINATION
CANDIDATES & % PASS
120
100
80
60
40
20
0
ENTRIES
PASSES
% PASS
1944
1945
1946
1947
1948
5

FIG. 5.

some closely related function, then the appropriate course is that which is specifically designed to develop the necessary characteristics, which are, an appreciation of materials and fitness for purpose ; quality and cost and the ability to approach production analytically and to recognise the problems involved in co-ordinating human effort and machine effort with a high degree of efficiency. All these are qualities of the mature rather than the apprentice or student, but unless the educational pattern is designed to develop them, its results are sure to be disappointing and to affect economy. There is a difference between the " design approach " and the " production approach "—involving both technical and psychological factors. Both have equal importance, and both have their rightful place.

The subject analysis in Fig. 6 shows clearly the transition from the Graduateship Examination introduced in 1931 to the Associate Membership Examination which will be implemented in 1950. The introduction of such an examination is of major importance in the development of the Institution. It presents a re-assessment of the academic requirements of the Production Engineer for professional status, and at least ensures equality of standard with the examinations of other scientific bodies.

Such a re-assessment is necessary since, until the introduction of the Higher National Certificate in 1942, the Graduateship Examination was the only nationally recognised examination in Production Engineering. With the expansion of the courses in Technical Colleges, the two schemes—Graduateship Examination and National Certificate—became considerably out of alignment, and recent changes in productive technique necessitating a broad basis called for an extension of the technological content and a review of management content. Such extension is apparent from a comparison of the two schemes.

Most important of all, the increased recognition and growth in stature of the Institution emphasised the need for ensuring that its educational requirements are of such a nature as to enhance the qualification which membership implies.

An analysis of the Associate Membership Examination was published in the Journal for October, 1948, but I should like particularly to focus attention on Parts II and III. Part I embraces the fundamental sciences and corresponds to the Ordinary National Certificate stage.

Part II contains subjects of technology which, by selective combination, cover a wide field in the application of engineering to production. Of these subjects, the most common combination in College courses is that of Machine Tools, Jig and Tool Design, and Metrology, whilst Jig and Tool Design is a main subject in all the courses. From this it is apparent that full advantage has not been

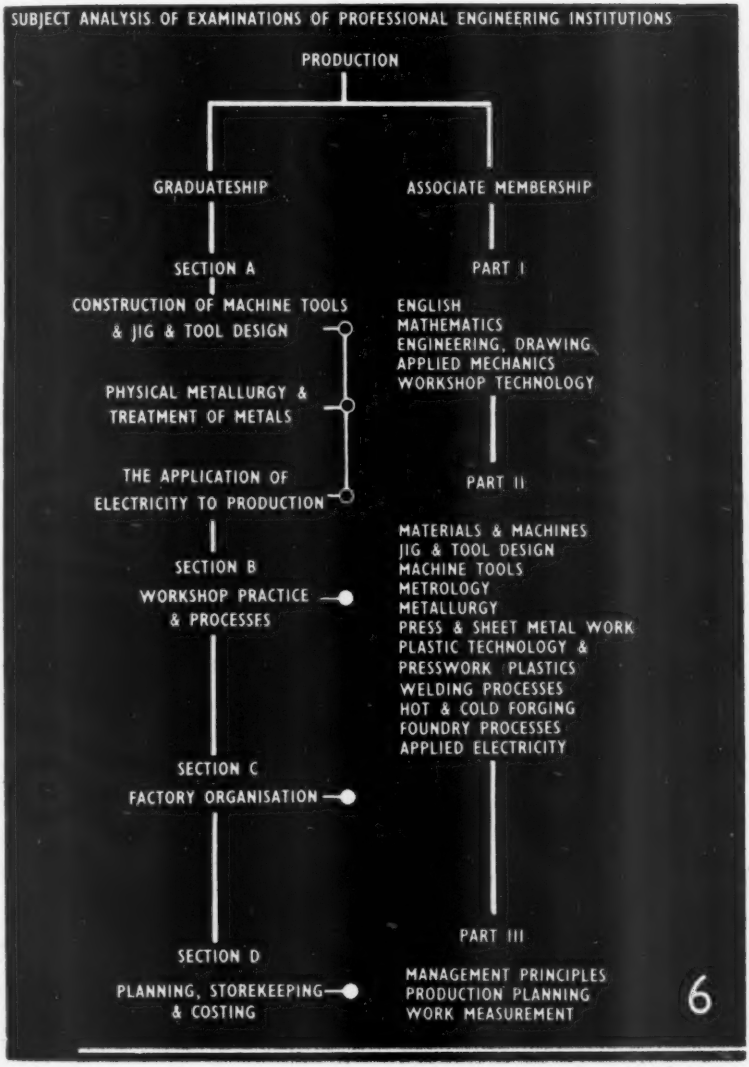
SUBJECT ANALYSIS OF EXAMINATIONS OF PROFESSIONAL ENGINEERING INSTITUTIONS
PRODUCTION
GRADUATESHIP
ASSOCIATE MEMBERSHIP
SECTION A
CONSTRUCTION OF MACHINE TOOLS & JIG & TOOL DESIGN
PHYSICAL METALLURGY & TREATMENT OF METALS
THE APPLICATION OF ELECTRICITY TO PRODUCTION
SECTION B
WORKSHOP PRACTICE & PROCESSES
SECTION C
FACTORY ORGANISATION
SECTION D
PLANNING, STOREKEEPING & COSTING
PART I
ENGLISH
MATHEMATICS
ENGINEERING, DRAWING
APPLIED MECHANICS
WORKSHOP TECHNOLOGY
PART II
MATERIALS & MACHINES
JIG & TOOL DESIGN
MACHINE TOOLS
METROLOGY
METALLURGY
PRESS & SHEET METAL WORK
PLASTIC TECHNOLOGY & PRESSWORK PLASTICS
WELDING PROCESSES
HOT & COLD FORGING
FOUNDRY PROCESSES
APPLIED ELECTRICITY
PART III
MANAGEMENT PRINCIPLES
PRODUCTION PLANNING
WORK MEASUREMENT
6

FIG. 6.

taken of the alternatives, and a future development of considerable importance should be the provision of courses covering other fields and embodying alternative groupings. Moreover, since production engineering subjects are not studied as major subjects until after the Ordinary National Certificate stage, such development would ensure a satisfactory groundwork in fundamental science. This may involve a re-assessment of syllabuses but the basis for satisfactory development is there and in this, I commend industry to review the provisions and to state its requirements.

Before considering the much discussed and important sphere of management studies, some comment on specialisation generally is necessary. It has been said that " early specialisation means sterilisation " and both in America and this country it has become the practice to condemn many schemes of technical education as narrow and too specialised. This criticism has now extended to the Universities, and like all true criticism is valuable in suggesting future action.

But, whatever the virtues of a broad non-specialised education, and they are many, we must face the fact that our modern civilisation is one of specialisation. To neglect this fact spells economic disaster. Arnold Toynbee has said : " Our modern western science is empirical and experimental ; its discoveries, therefore, lend themselves readily to practical application in the realm of technology." Such applications have become legion and specialisation has been forced upon us, and we must achieve a compromise which is both progressive and practical. Moreover, it should not be forgotten that different plants thrive best in different soils, and educational horticulture is always an experiment and never a technique.

MANAGEMENT Part III of the Associate Membership Examination concerns management and the tools of management. Since 1945 more and more appreciation of the scientific approach to management, and hence of the need for rationalisation of management studies, has resulted in intense research into the subject. This is universal and in the pleas for more and more production there is often the associated call for more efficient management—I prefer to call it better management. Technology cannot stand alone as the prime cause of productive achievement—it occupies a twin pedestal with management, and I reiterate my opinion that it is the happy marriage of the two which will achieve the most economic production.

Part III of the examination, and to some extent the corresponding post-certificate stages in Technical Colleges, embodies a general management subject and a management " tool." Thus an oppor-

tunity is given for those who have acquired a basic knowledge of the "technologies" to round off their studies by concentrating on human problems as distinct from material ones.

The age at which management studies and examination should take place is of great importance and the Urwick Report emphasises the need for some degree of maturity in this respect. In the case of the Production Engineer it is fundamental that he should preserve the balance between Technological and Management studies, and by satisfying technological requirements first—during his industrial initiation—he will ensure the necessary degree of maturity in both personal attributes and technical attainment. It is the considered opinion of the Institution of Production Engineers that managers should be chosen from all levels but with the vital qualification that they should be chosen entirely for their potentialities and ability to lead and direct.

In considering future developments, I shall have more to say concerning the field of management studies, but it is important to realise that management is the "responsibility for the work of others" and in associating management and technology, we are more likely to avoid unbalance in either field than by concentrating on one and neglecting the equal partner. I think it will be agreed that the most important "management tools" for the Production Engineer are "Planning" (widely interpreted) and "Work Measurement" which implies the scientific appraisal of effort and the rational reward for effort, applied with or without financial incentive content.

With such a background as is implied in the analysis, Production Engineers should be able to proceed to a further study of Higher Technology or Management, and provided the reports mentioned in the introduction are implemented liberally, there should be considerable development in the facilities for such studies. It is our duty to appreciate the needs of our time and to take a major part in satisfying them.

PRODUCTION ENGINEERING EDUCATION (SECTIONS ABROAD)

Although the analysis has dealt with schemes in this country, it would be unfitting and incomplete without inclusion of schemes for the education of the Production Engineer abroad. Indeed, this presents a welcome opportunity to pay tribute to the efforts of the Sections in those countries where conditions of location and dispersal are so much more difficult than here.

Figs. 7 and 8 show the general lay-out of schemes in Australia and South Africa. With regard to Australia, courses in addition to that at the Melbourne Technical College have been instituted in Sydney; and the considerable success of the course in Melbourne promises well for future development. To a rather less extent the

AUSTRALIA—MELBOURNE TECHNICAL COLLEGE

LAYOUT OF CERTIFICATE COURSE IN PRODUCTION ENGINEERING

1st Year		2nd Year		3rd Year	
Subject	Time	Subject	Time	Subject	Time
Machine Tools and Jig and Tool Design	1 Evening per Week, 2 Hours	Production Plant and Processes	1 Evening per Week, 2 Hours	Industrial Electricity	1 Part Evening per Week, 1 Hour
Practical Mathematics	1 Evening per Week, 2 Hours	Jig and Tool Design II.	1 Evening per Week, 2 Hours	Metrology and Inspection	1 Part Evening per Week, 1 Hour
Prod. Drg. Procedure Materials and Quality Control	1 Evening per Week, 2 Hours	Industrial Management I.	1 Evening per Week, 2 Hours	Production and Project Planning	1 Evening per Week, 2 Hours
				Industrial Management II.	1 Evening per Week, 2 Hours
Hours per Week	6		6		6

7

FIG. 7.

ENGINEERING COURSES UNION OF SOUTH AFRICA

NATIONAL TECHNICAL CERTIFICATES

LAYOUT OF PRODUCTION ENGINEERING COURSES.

A MINIMUM OF THREE SUBJECTS TO BE TAKEN FOR EACH GRADE.

N.T.C.I	N.T.C.II	N.T.C.III
MATHEMATICS I ENGINEERING DRAWING I FITTING & TURNING I	MATHEMATICS II APPLIED MECHANIC I MACHINE TOOLS & FITTING I MACHINE CONSTRUCTION AND DRAWING INDUSTRIAL METALLURGY I	MATHEMATICS III APPLIED MECHANICS II MACHINE TOOLS & FITTING II

NATIONAL ADVANCED TECHNICAL CERTIFICATES

A.T.C. I.	A.T.C. II.	
MATHEMATICS IV STRENGTH OF MATERIALS I JIG & TOOL DESIGN I	CANDIDATES MAY SELECT EITHER I OR II	
	I JIG AND TOOL DESIGNERS	II PRODUCTION ENGINEERS
	JIG AND TOOL DESIGN II MOTION AND TIME STUDY PLANNING, COSTING & ESTIMATING	MOTION AND TIME STUDY PLANNING, COSTING & ESTIMATING PRODUCTION CONTROL.

NATIONAL DIPLOMA IN PRODUCTION ENGINEERING

SIX SUBJECTS SELECTED AS FOLLOWS :—

GROUP I

PRODUCTION CONTROL II
INDUSTRIAL WELFARE & PSYCHOLOGY
WORKSHOP ORGANISATION & MANAGEMENT

GROUP II THREE FROM :—

JIG AND TOOL DESIGN II
MOTION AND TIME STUDY
PLANNING, COSTING AND ESTIMATING
MATHEMATICS V
STRENGTH OF MATERIALS II

8

FIG. 8

National Technical Certificates of South Africa have gained exemption from the Institution's examination requirements. Although at the moment no recognised courses in Production Engineering exist in India, there is a growing awareness of the need for development in this field to match the industrial expansion which is taking place. With the establishment of an All-India Council for Technical Education, there is no doubt that such development will take place, through the agency of the Calcutta Section and the proposed Section in Bombay. The Government of India are more than aware of the important part the Institution can play in the development of Indian industry and the complementary schemes of technical education for production engineering.

The courses depicted in Figs. 7 and 8, although showing considerable divergence from schemes in this country, combine efficiently those subjects deemed desirable in the education of the Production Engineer. The standard of entry is high; for instance in Melbourne, the students commence the course after having completed their apprenticeship, whereas in this country the courses are usually considered part of the apprenticeship. Here again, I must defer comment until future developments are considered. The schemes were designed to satisfy the educational requirements for Graduateship and have been very successful. It is not certain as yet what effects the Associate Membership Examination will have or what modifications will be necessary, but Sections abroad may rest assured that their problems are appreciated and that every help will be given to them in any changes which may be necessary.

DISTRIBUTION OF COURSES IN GREAT BRITAIN

This survey would not be efficient unless a little time were spent in consideration of how local industry is served by courses for the education of the Production Engineer. Figure 9 shows the location of those Technical Colleges which are at present operating Higher National Certificate Schemes in Production Engineering.

Since the lecture was prepared, other schemes have been approved and there are now, in addition to those shown on the map, courses in Scotland at the Royal Technical College, Glasgow, and at the Heriot-Watt College, Edinburgh. Scotland has always been justly proud of its educational achievements and there is no doubt that considerable developments in Production Engineering Courses will take place there. Courses have also been established at Brighton, Cheltenham, Gateshead, Luton, Croydon and Woolwich and there are others in process of development. It is evident that the Midlands and London area are well served by courses — not always well supported, however—but the diagram cannot in this instance give a detailed picture except to indicate that there appears to be a lack of facilities in the Eastern Counties, the North-East, South Wales

AREA DISTRIBUTION OF HIGHER NATIONAL CERTIFICATES COURSES

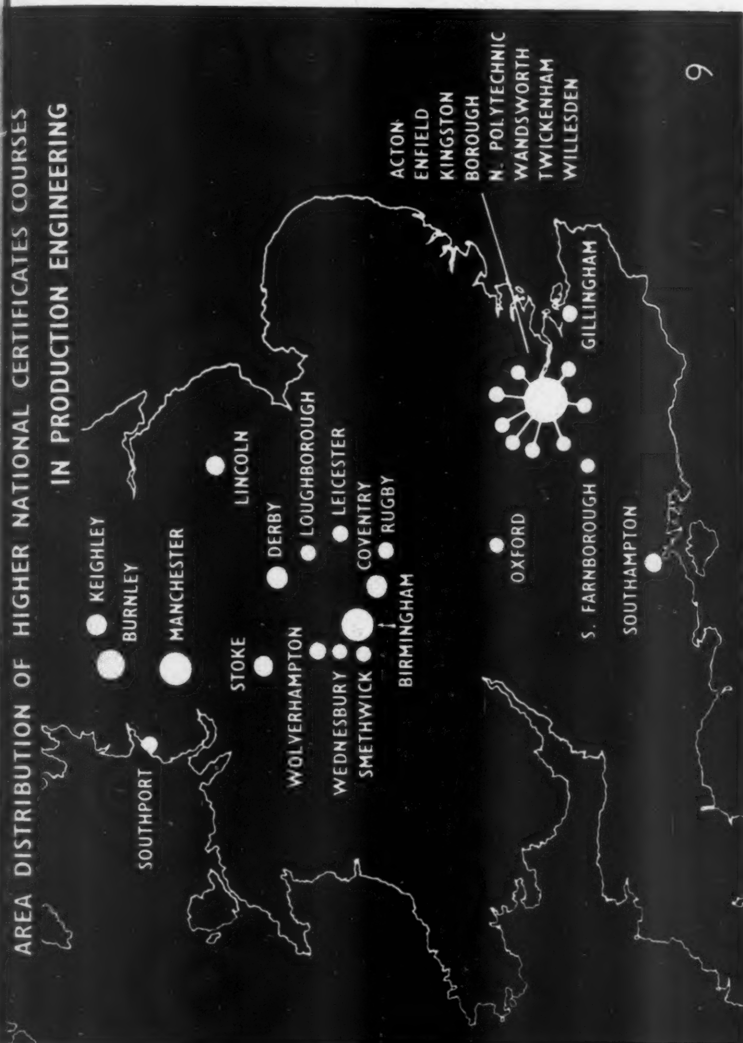
AREA DISTRIBUTION OF HIGHER NATIONAL CERTIFICATES COURSES
IN PRODUCTION ENGINEERING
9
SOUTHPORT
KEIGHLEY
BURNLEY
MANCHESTER
STOKE
LINCOLN
WOLVERHAMPTON
WEDNESBURY
SMETHWICK
BIRMINGHAM
DERBY
LOUGHBOROUGH
LEICESTER
COVENTRY
RUGBY
OXFORD
S. FARNBOROUGH
SOUTHAMPTON
GILLINGHAM
ACTON
ENFIELD
KINGSTON
BOROUGH
N. POLYTECHNIC
WANDSWORTH
TWICKENHAM
WILLESDEN

Fig. 9.

and Ireland, and in the South of England. It should not be assumed, however, that development is lacking in those areas, and I know that in due course provision will be made. It is in such educational development that the Sections, with their intimate knowledge of local conditions, can play a most important part, particularly with respect to the Regional Advisory Councils for Further Education. In terms of student numbers and treating the areas as lateral bands rather than closed boundaries, the percentage representation is of the following order :

North	10%	1947
North Midlands	18%	
Midlands	44%	
London Area	25%	
South	3%	

Such a pattern is never static so it may be that in future considerable change will have taken place. It should be remembered, however, that the demand must come from Industry and there must be a reasonable degree of permanence in the demand as the establishment of the necessary laboratories and the recruitment of suitable staff is both expensive and difficult today. I should like to acknowledge the considerable co-operation and courtesy I have received in my inquiries and liaison with Technical Colleges, backed by the warm support and appreciation of the Ministry of Education. I would mention specifically the North Staffordshire Technical College and the Acton Technical College, who have given permission for extracts from their publications.

FUTURE DEVELOPMENTS In education it is always wise to proceed from the known to the unknown, and I think that the schemes outlined will form the main educational avenues of education for the Production Engineer, and that future developments will be in the two major fields of Management and Higher Technology. The field of management is depicted in Fig. 10, taken from the prospectus of the Acton Technical College and it will be seen how closely Technology and Management are linked. I wish to emphasise what I think should be the main developments, and to stress the important part the Institution is fitted by its constitution and corporate ability to play in such developments. Underlying all such considerations is the changing outlook concerning productivity and I repeat that, important as it is, technology is an equal partner and not the sole operator. Management functions are considered of equal importance and may be more so in certain conditions. Recently, the installation of faster equipment has been approached with a certain hesitancy since it involves human relations and reactions, as well as technology. The second

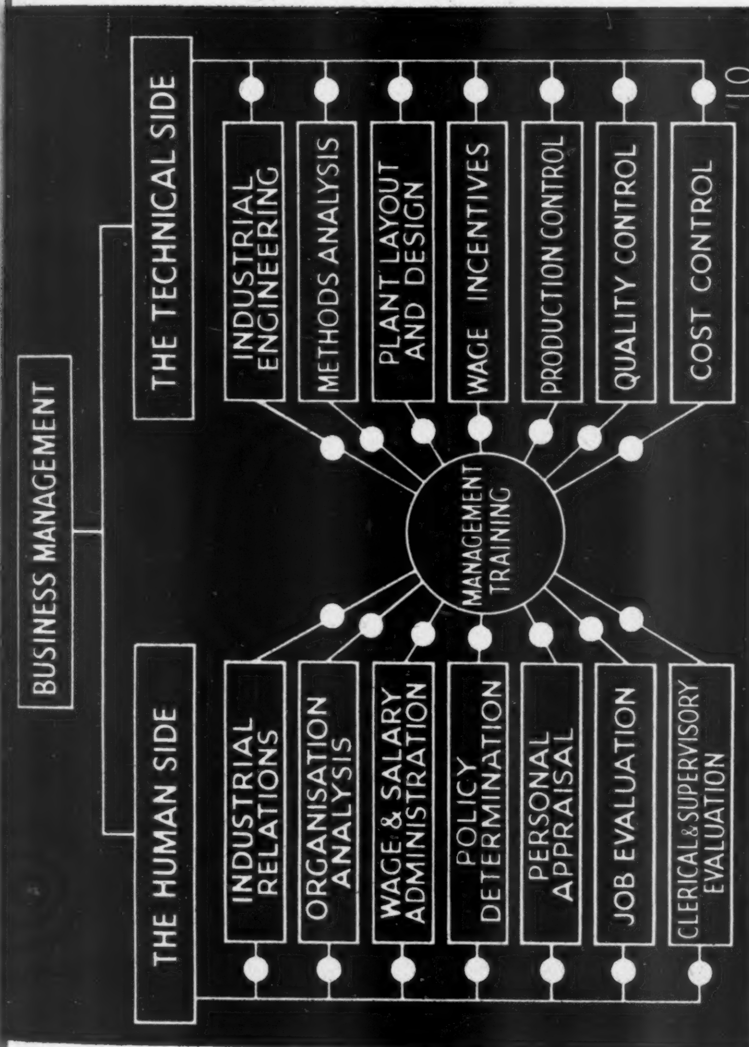
BUSINESS MANAGEMENT
THE HUMAN SIDE
THE TECHNICAL SIDE
INDUSTRIAL RELATIONS
ORGANISATION ANALYSIS
WAGE & SALARY ADMINISTRATION
POLICY DETERMINATION
PERSONAL APPRAISAL
JOB EVALUATION
CLERICAL & SUPERVISORY EVALUATION
MANAGEMENT TRAINING
INDUSTRIAL ENGINEERING
METHODS ANALYSIS
PLANT LAYOUT AND DESIGN
WAGE INCENTIVES
PRODUCTION CONTROL
QUALITY CONTROL
COST CONTROL
10

Fig. 10.

qualifying thought is that until recently the Universities have had little or no part in the education for careers in production engineering, with the exception of those whose constitution embodies a college of technology as the Faculty of Technology. In this connection, a very recent development of major importance is the establishment of a post-graduate course in Metrology at the Manchester College of Technology, and it is likely that courses of similar standards will be established for Machine Tools. There is much to be said for the idea of considering the education of the Production Engineer as specific to senior Technical Colleges, and of considering the Universities as research fields. Thirdly, the study of production engineering in the United States of America invariably concerns management functions and achieves a technological content by recruiting from students who have already graduated in engineering.

I commend to you, therefore, a careful sifting of all that we have learned concerning productivity since 1945 and I am certain that you will be convinced of the need for a major development in which the Colleges of Technology envisaged in the Percy Report and the Universities should provide ample facilities for the study of scientific management and research in the technology of production. Indeed, there is a movement in this direction as indicated by the pioneer establishment of the Lucas Chair of Principles of Engineering Production at Birmingham University and the Kenward Research Fellowship in Industrial Administration at St. Catherine's College, Cambridge. However, I would not anticipate the highest efficiency if such development were limited to a closed University field in which the only qualification recognised for entry to these advanced courses was an engineering or science degree, or that the schemes should be administered from academic ivory towers remote from industry. The minimum qualification for entry to post-certificate or post-graduate courses should be a Higher National Certificate in Production Engineering, with the complementary condition that entrants should have had adequate industrial experience of an executive nature, so that the conditions inherent in any productive enterprise are fully appreciated. The nature of the curriculum should avoid academic remoteness, and this would best be accomplished by field research and investigation by the group method, which ensures co-operation and pooling of ideas. Such research would, of course, follow a period of study by discussion in which the basic tools of production management would be appraised and analysed, and which would be analagous to "initiation training." Although teaching by the "case method" has, for some indefinite reason, been given scant attention in this country, it is particularly suited for advanced studies in the realms of production engineering and there is scope for considerable

development of such a technique. The courses run by industrial consultants should be increased as they form a sound field for post-certificate studies.

All Sections of the Institution should anticipate such developments which depend for their success upon ready co-operation from industry, and in such development, the Institution is particularly fitted to participate since its boundaries are wide and its corporate experience not only wide but deep in the science of productive engineering, and embraces human relations on an extensive scale.

Regionally, the educational requirements are being surveyed by Regional Councils whose reports will be co-ordinated by the National Advisory Council for Education in Industry and Commerce.

I hope that these deliberations will result in the rapid establishment of Colleges of Technology which will command world-wide recognition and respect. It may be that the most fruitful development in this respect will avoid the duplication evident in some of our present schemes by encouraging such Colleges to provide specialised services of information and investigation. In fact, such a development is already shaping in the National Colleges such as those for the Foundry Industry, Heating, Ventilating, Refrigeration and Fan Engineering, Aeronautics, Horology and Instrument Making, and Rubber Technology. In any future development very careful thought and planning must be given to the provision of correctly designed and equipped laboratories for both technology and management investigations. This leads to the thought that there is room in our educational system for a College of Technology, specialising in production engineering, which would ensure the ability to correlate world-wide productive engineering developments in technology and management, and to apply them throughout the major fields in all industries which use the science of engineering as a productive agent.

It is apparent that " men " will always be more important than " matters " and herein lies a fundamental indication upon which the whole success of future development will depend. Unless the combined efforts of the Universities, training colleges and industry are directed to providing an expanding body of teachers who have had the opportunity of acquiring not only knowledge, but the ability to apply it to current problems and to direct their students in their approach to problems of productivity, no real development can take place. All aspects of production are dynamic and this is equally true in the teaching of the subject. Industry has been quick to appreciate this and is to be commended on the many successful management courses now running. I feel that if such schemes were expanded to embrace longer periods in both industry and college, they would prove of great value.

The final stage in such development is an expansion of such

establishments as Ashridge, so that more could enjoy and profit by a return from industry to residential courses offering facilities for discussion rather than instruction, and for the interchange of experience and ideas.

What a splendid achievement we could claim if this Institution could develop such courses in Technology and Management—it achieves this partly at Section Meetings, but I think the idea is worthy of further thought.

CONCLUSION Much as I should have liked, I deemed it undesirable to attempt to include in this survey a detailed analysis of training schemes, as that would present a major operation in itself. I would, however, express the firm conviction that much benefit would result from a critical analysis and that there is probably a need for some considerable change in our ideas as to what constitutes an efficient complementary scheme of practical training. All I can contribute here is to state what I consider are the fundamentals of any schemes of practical training and they are " adequate initiation," regular information to and from apprentice, progressive training coupled with frequent review, and most important, flexibility with respect to apprentices' development and reaction throughout the scheme.

In attempting to place before you an educational analysis concerning the Production Engineer, I may not have given the attention to certain details you would wish, and I hope these will be covered in discussion.

Indeed, I hope that through the interchange of ideas and by ample contribution to the general body of knowledge, we shall be able to make a resounding contribution to future development in the educational schemes, so that those concerned with Production Engineering in all its aspects will gain world wide recognition as not only anticipating the needs of their time, but as the authors of major contributions to educational schemes of national importance and international repute.

EXTRACTS FROM DISCUSSIONS

LONDON SECTION The CHAIRMAN (Mr. J. E. Hill, M.I.P.E., Chairman of Council) said that before introducing Mr. Worth it was his privilege to introduce Professor John R. Immer, of America, whom it was a privilege to have on the platform. During the war he served on the staff of the Quartermaster General stationed in England and France, and on demobilisation joined the Illinois Watch Case Company as a time study engineer. Later he was on the staff of the University of Minnesota as Assistant Professor of Engineering Management. He was also a member of the Industrial Manage-

ment Society of Chicago and Education Chairman of the Minnesota Materials Handling Association. After the lecture, the Chairman added, he would ask Professor Immer to say a few words on the American idea of training engineers.

The purpose of the gathering was to hear a lecture from Mr. T. B. Worth, M.I.P.E., Associate Member of the Institution of Mechanical Engineers and also Associate Member of the Institution of Electrical Engineers. It was as well to take this opportunity of saying a few words in regard to Mr. Worth's previous experience, because many people thought of educationalists as speaking in a very abstract way about the training of engineers.

Mr. Worth had served as an engineering apprentice and had spent thirteen years in industry. Subsequently he had taken up technical teaching, first as a part-time, and later as a full-time, lecturer at the Leicester College of Technology, and at the Coalville Mining and Technical Institute. In 1941 he had been appointed Head of the School of Army Technicians in the Leicester College of Technology and had carried out the basic training of engineers for His Majesty's Forces. Afterwards, in 1944, he was appointed Head of the Production Engineering Section of the Birmingham Central Technical College. He joined the Institution of Production Engineers in 1948 as Education Officer, previous to which he had served on many of the Committees of the Institution, in particular the Education Committee. He had therefore, the necessary experience to lecture that evening on the education of the Production Engineer, and it was a great pleasure to introduce Mr. T. B. Worth.

MR. WORTH said he thought that it was a good augury for education that so many had eschewed the delights of London to come and listen to him, and he hoped they would find much in the lecture to provoke discussion and also thought on future developments.

THE CHAIRMAN said he would take the opportunity of asking Professor Immer to open the discussion and give them the American view so far as this subject was concerned. Sir Stafford Cripps had recently asked them to fall in with their American friends in regard to improving industrial relations and productivity, and this was an opportunity to start in the field of production engineering and the education of Production Engineers.

PROFESSOR IMMER said he had just heard from Mr. Worth information he had been trying to obtain all the summer and therefore particularly appreciated the lecture.

While Mr. Worth had been speaking, he had been trying to think how best to present, in a few minutes, the main differences between training in the United States as opposed to training in Britain. Basically, in America it was recognised that sooner or later the successful Production Engineer moved into management.

It was believed that management required more training than had been given to engineers (strictly speaking) in the past. For example, he might cite—in American Universities—the five-year course in which the Institute of Business Administration, of which he was a member, dealt with engineers who had graduated : engineers who, incidentally, had not had an apprenticeship period but came direct from four years in an engineering school for an additional year of business training. This training included courses such as accounting, advanced time and motion study, production standards, factory lay-out, personnel problems, labour relations, economies and advanced economics, business finance, and so forth. Some people might say that was beyond the realm of the Production Engineer, but this training was based on the contention that the successful Production Engineer very soon moved up and became part of management.

It had been found that even the pure scientist and the pure chemist—uncontaminated by engineering, as engineering was understood in Britain—if he was successful ended up as a manager, the manager of a chemical firm or a division of chemical research. Even in the hospitals there was a place for scientific management or industrial management. So the point was being reached where there was an almost unlimited field for management, and that was particularly true for American engineers.

It was therefore stressed that engineers, in addition to having regular engineering training, should have a thorough grounding in what was termed industrial management, in economics and accounting and cost accounting. Particular emphasis was laid on accounting and cost accounting, and on obtaining some idea of the broader relationships of the business. It was perhaps a little harder, in some ways, because after the engineer had finished his degree he would start in a company not on the managerial level, but at the lowest level, which might be that of the time study methods man ! He lacked the advantage of an apprenticeship training, and he got into what had been described as the bottom dregs of the business, but quite quickly, with his background and usually with nothing else to aid him, he seemed generally to work out at the top. That seemed to be the main distinction between the American and British methods of educating engineers at the present time.

The CHAIRMAN then declared the meeting open for discussion.

MR. A. M. JACOBSON said there seemed to be two aspects to the problem. On the one hand there was the training of established engineers for the business of production ; on the other, there was the producing or turning out of educated Production Engineers,

people who had trained from the beginning for the business of producing. In any suggestions as to future policy, these two aspects should be borne in mind.

He had himself one or two constructive suggestions to put forward with regard both to the training of engineers and the business of production and the turning out, or production, of Production Engineers.

Many schemes were in operation by certain firms for apprentices and students ; they came under the category of general training. But the Production Engineer could not be trained in a college. A critical analysis could usefully be made, therefore, by the Institution of Production Engineers, of the steps already taken by manufacturers throughout the country.

Secondly, he was convinced, with regard to the question of a University for Production Engineers, that most of the trouble at the present time was due to failure to attach sufficient importance to the business of producing. One could become trained as an engineer in the American sense of the term—a designer—at most of the large Universities, particularly at Cambridge ; but one could not specialise entirely in the business of production, and many young people had been faced with the problem, should they become first-rate mechanical engineers and then try to become Production Engineers afterwards ? He felt very strongly on that matter and would like to think that the Institution of Production Engineers—he appreciated here that he was following up a suggestion made by Mr. Worth—were going ahead with the idea of an appeal not just for a technical college—because the word had in many respects quite a nasty taste when compared with the University, for all that it might mean in Latin. It had not quite the same status, the same importance. They needed to raise the prestige attached to the business of being a Production Engineer. Only by driving that point home and possibly by developing a University would they go forward ; and in his opinion the Institution was the body to do that. Millions of pounds were being distributed for aeronautical colleges, the training of test pilots, atomic research ; but only a very limited sum in the very direction in which it would produce dividends.

Finally, he would ask the Institution to consider at even greater length than they had already done this central college. Let it be the University of Oxford for Arts, Cambridge for Engineering, and some other town of equal or greater importance for the business of Production.

MR. WORTH said he thought the first suggestion—a review of training schemes—would be carried out in time.

He was glad of the support given to the idea of a College specialising in Production Engineering. It was a long-term view,

necessarily ; it must be remembered that the expansion that had been portrayed had taken place in the past five or six years. The Graduateship Examination, which went back to 1931, extended the period, perhaps, to ten or fifteen years. It was fundamental, however, no matter how long it took, to press home the idea that there was a need for it. It should also be emphasised that the term " Production Engineering " had a very wide interpretation and could cover productivity as a whole, seeing that, as had been stated in the lecture, the translation of scientific thought into production achievement needed engineering.

MR. ALBU disagreed with the previous speaker on one particular aspect of University training. Nothing could be more disastrous than the establishment of Universities in a particular science or technology. The whole idea of a University was that people should be brought into an atmosphere of differing points of view. It was equally bad for the classicists and historians and economists if they had no contact with the engineers and scientists, as for the engineers and scientists to be brought up without contact with the humanities. The humanities could not be taught by rote. If Production Engineers were to reach the higher posts in management they must be brought up in this atmosphere of broad human thought, of contact with other subjects. They would not then go out into the world the narrow, scientifically and technically trained people they very often were at the present time, placed at a disadvantage when they came to deal with people brought up in other walks of life. It would be absolutely disastrous to carry out training for Production Engineering in isolation from the other social activities of daily life. That was where the education of the Production Engineer had failed so far.

MR. WORTH pointed out that in suggesting University training he had not specified that the subject should be taught in the University : it was an idea that was under consideration. Secondly, he would repeat that different plants grew in different soil. 60 to 70 per cent. of the industry of the country took place in firms that employed less than 100 or 150 employees. An institution of the calibre of the Institution of Production Engineers must not neglect the facts regarding the constitution of industry as found in the country at present, and the schemes he had outlined were to his mind a reasonably satisfactory attempt to meet all the degrees of industry throughout the country.

MR. BENTLEY said that his strongest criticism of the lecture was that it described a long-distance programme for the training of the future Production Engineer. He was under the impression that the country was in difficulties at the present time and that the education

of the present Production Engineer was more important than concentrating on the future. Unless the present engineer got busy, there would be no future worth talking about.

The result of the speaker's experience was that the present-day Production Engineer would advance his education more in six months by following each operation through his factory for time-study, than in seven lifetimes of talk in a technical college or other institution.

MR. WORTH said that he had not presented a long-distance programme entirely, but it would have been very wrong to describe what had been and was being done, and to leave it at that. He had had, of necessity, to show in his concluding remarks what might be done in the future. Nor had he neglected to indicate what steps might be taken to improve the present-day Production Engineer.

For the potential Production Engineer—the student, the junior member—and after all the subject of the lecture was education—much would be achieved with the improvement of the Higher National Certificate type of course, the improvement in teaching technique, the liberal supply of equipment to colleges, the re-organisation of laboratories, and the rebuilding programme. Moreover, the courses which had been running in many colleges for executives would also help to raise the status of the Production Engineer.

He was glad background had been mentioned : the method of providing background in Britain was rather different from that in America, but both had their values.

Much of what the last speaker had said was very true, but some of his criticism was not really justified in view of what was being done, what could be done, and what might be done in the future.

MR. SACHS thought attempts should be made to improve the status and quality of production engineering by putting it on a par with mechanical or electrical engineering in the fourth, or perhaps the third, year of specialisation in the degree course. That was done on the Continent, and he had recently had the good fortune to visit and see the curriculum of the Swiss Federal Institute of Technology. One of the most valuable features was the very close liaison in the fourth year between the University and industry. The professor in charge was placed as a high official in one or two works in a consultative capacity, where he had immediate access to the Directorate. Students could be placed in factories where they could examine the set-up and organisation. In one case a fourth-year student was required to write a thesis on the running of the railway stations of one line, and to do this he had to visit 246 stations for the purpose of making a time and motion study of the Station Masters, and so on. He was also required to make

recommendations for the improvement of the administration of railway stations. It amounted to a very big thesis, combining academic and industrial training, a method highly desirable in any future programme of education.

MR. WORTH said that the Whitworth Scholarships did embrace the subject of Workshop Technology, and that was a move in the right direction. The standard in some technical colleges was first-class. Birmingham, where he had the honour to serve for four years, had established a diploma course which had a common first year for all students. In the second year they diverged partly into mechanical, electrical and production. In the final year there was complete divergence, so that all three—mechanical, electrical and production—were covered on the graduate side.

MR. DOUBLE suggested that the business of Production Engineering, however it may be defined, might be taught and encouraged more readily if the executives of various firms were asked to lecture occasionally to their own employees and to teach them how to handle the general problems of the factory or business.

To give an example, one firm might specialise in making small electric motors—buying the raw material, cutting it up, assembling selling, exporting. Another might specialise, say, in the manufacture of radio valves. The problem in each case was to produce as many as possible as cheaply as possible. Yet the Production Engineer in one of those factories would have to obtain his knowledge through several years in that factory. His knowledge and field of activity would, however, be quite different from those of his colleague in the other factory. In other words, the experience of the man concerned with commutator motors would be quite different from that needed by the man producing radio valves. Could such experience and knowledge be taught in a production engineering college at all?

It would seem from what Mr. Worth had said that some of the proposed syllabuses were not markedly different from those provided for the Higher National Certificate or even for a degree course. Probably the best way to become a Production Engineer, once the appropriate qualification had been acquired, would be to go into a factory and work from the bottom upwards through the hard knocks of experience. He was puzzled as to whether any amount of teaching could turn out a Production Engineer.

The difficulty might be overcome by encouraging executives to go to a college two or three times a year to teach their own apprentices exactly what the problems were and how they could be met.

MR. WORTH fully agreed that no college, no matter what its

standard or location, could turn out accomplished Production Engineers. That fact was accepted and fully appreciated. But they could contribute a very great deal towards the finished article.

With regard to lectures by executives, it must be remembered that such schemes did exist. There were many excellent training schemes organised by well-known firms. On the college side many more intensive courses were being arranged, and the lecturers were experts from industry.

Whatever was being manufactured in the factories, there were fundamental principles which could be applied. There were, for instance, certain principles in motion study and motion economy which could be taught in college and experimented with, and which would give greater output with less effort. There were common principles, again, in jig and tool design, which could be taught. Many of those present would know the six principles of freedom. These fundamental principles of revolution and translation along three mutually disposed axes were common to all motion and could be taught. There was, however, a definite need for an extension of the scheme by which industry allowed its executives to go into the colleges, and the students to go out from the colleges to industry, and thus get a better Production Engineer.

A member said he thought Mr. Worth had overlooked one factor in his scheme. That scheme was for the student and it was based on the assumption that the right material would present itself. It was, however, a very important part of any scheme of education for Production Engineers to educate managements and personnel officers in order to break down the old conservative idea that the most suitable candidate was the lad who was not quite up to the National Certificate Course in Mechanical Engineering. That idea was very prevalent in the London area.

Secondly, Mr. Worth's chart did not indicate what provision was made for the student taking a City and Guilds Course who was felt to be capable of transfer to the Higher National Certificate Course.

MR. WORTH agreed that a higher degree of success would be achieved with greater knowledge of how best to select the right human material. Much research was being made into this matter, however, and some of the techniques of the past proved negative rather than positive. There again it was a matter of development.

It was a just criticism that the idea prevailed in some quarters that production engineering made less demand on the student than the longer-established courses in mechanical and electrical engineering. He himself had had to fight it, but again it was a question of time. The new Associate Membership examination—drawn up in direct consultation with the Ministry of Education—should help. The idea that the Production Engineering student

was one not quite capable of taking a mechanical course was definitely wrong and should be contested. People in industry, particularly those on the personnel side, should be quite certain in their minds that it did require a very great degree of judgment in many respects. Mathematics might be a more exact science, but production demanded judgment. There were often two or three methods of tackling a problem, each of value in relation to the conditions for its application. He had no hesitation whatever in saying that production engineering made serious demands upon ability.

With regard to the City and Guilds course, there had been many requests, during his talks at technical colleges, that steps be taken to enable a student to transfer from one course to another. He did not want to bore them with the educational content of courses, but if that did happen the student might embark on his Higher National Certificate Course severely ill-equipped for that course in virtue of his previous background.

Considerable attention had been given to this subject and it was desirable that a student who showed promise in the first year of his City and Guilds or Trade training should complete that training before attempting to transfer.

Mr. Gordon England suggested that the Institution of Production Engineers had nothing to do with education. It had something to do with the acquisition of learning and knowledge, but education was outside its particular responsibility and duty.

This being a lecture meeting on education, they should be very careful in the use of terms. Mr. Worth had been good enough to say that Plato had a definition for education. There was only one definition that was worth-while—the ability to think. An educated man was one who could think. A learned man was one who was a specialist on some particular subject or other.

He would like to support Mr. Albu wholeheartedly on the question of a University of Production Engineering. At the most, there could be a college attached to a University. The blending of minds on all subjects was most important, and it did not come through being a specialist.

The failure that evening, however, was to tackle a subject raised by the speaker who said, in a plea from the heart, that he would like to do something now. His own experience—and it was probably shared by most of those present—was that the older one got, the more ignorant one felt. The Institution could make a really serious contribution to present-day problems by organising a first-class post-graduate set of courses. It would be of immense advantage if Production Engineers, with their failures and successes, could get together at regular intervals as they proceeded along the course of management. That was what he would like the Institution to

concentrate on ; it could be done very quickly, and some of the benefits could be enjoyed by all who were present that evening. They should not only work for posterity ; posterity had done very little for them at the moment. There should not be so much talk about the young fellow. Quite frankly he wanted to talk about the man who was already in industry, who had his feet on the bottom rung and wanted to climb up. Industry was apparently ignorant of the fact that this was the time to start educating such men, because it gave them an opportunity to unlearn half the things found in text-books—precipitated and frozen information which was probably of little or no dynamic value.

MR. WORTH said he was glad of an opportunity to cross swords once again with Mr. Gordon England, for whom he had great respect. He wanted, however, to quote again from his lecture in reply. He had said what a splendid achievement it would be if the Institution could develop such courses in Technology and Management as were established through Ashridge, though perhaps not on the same scale, courses at which a return from industry could be effected and which offered facilities for discussion rather than instruction and for the interchange of experience and ideas. He had no further comment to make.

MR. BAILEY (Birmingham Central Technical College) said he would first like to point out that Mr. Worth had been practising the main schemes placed before them for the past four years at Birmingham.

Secondly, technical colleges seemed to have been assailed from two directions that evening. Some people thought it better to study the subject of production engineering in the academic atmosphere of the University. Others thought any sort of formal learning should be scrapped in favour of the hard way through the shops. The fact remained, however, that if a show of hands were taken it would probably disclose that most of those present had obtained their technical education at technical colleges and at the same time had served in industry. Most of them, that was to say, were part-time students at technical colleges ; and most of the present-day students were in the same case. Whatever might be the hope of the future, then, the technical colleges were the hope of the moment.

What could technical colleges do ? First of all, there were the schemes which the Institution had adopted as the basis for its new examination. Mr. Gordon England would no doubt be glad to know that the major technical colleges at any rate were reaching the stage when they could put on post-graduate courses. The technical colleges could also act as contributory centres ; and they had now a little more space, as the junior colleges were getting to

work. More staff was available too, and perhaps there would be an opportunity to ask Mr. Gordon England to lead some of the post-graduate courses in his particular subject.

A member said it was disheartening to hear from one speaker that he was not interested in the "young fellows." He himself had completed the Production Engineering Course at technical college during the past six months and had one or two thoughts on the subject which he would like to pass on.

Reference had been made to the equipment and facilities required for training young students in production engineering but where were the teachers to be found? That was of prime importance. It was too much to expect people, however good they might be at their subjects, to come after a hard day's work in industry to the technical college to give two-and-a-half hours' exhausting teaching in the evening. They were tired at the beginning and the students did not benefit a hundred per cent. He hoped some of the more advanced Production Engineers would find it possible to give up their jobs in industry and devote themselves to training the younger engineers.

Improvement in the lot of the junior engineer, especially in the production field, was largely in their own hands, he thought. It had been pointed out that industries could operate their own schemes, and the company with which he himself was associated ran a very successful engineering section which was open to all branches. Very good lectures were provided on vitreous enamelling and other productive operations. Those people who were sufficiently keen could put up ideas of this kind to their companies and try to get something going.

His own company was like an octopus with legs in many lands, the head and body being in America. It adopted the principle of choosing prospective executives from the lower ranks and sending them to the States for a course at the Flint University. That sort of thing was a great help in the education of the Production Engineer and others.

Finally he would like to repeat his appeal to Production Engineers to search their hearts and, if they felt the call, to take up this occupation of teaching.

MR. WORTH agreed that the young engineer must be looked after; although the position with regard to equipment was still difficult, it was becoming easier. There had been some first-class equipment at the Machine Tool Exhibition and some was better than in the past. He himself would like to see the laboratories and workshops at technical colleges planned as production units, so that experiments could be made with plant lay-out schemes and with scale models in the planning of line flow and functional arrangements.

The part-time student certainly came through the hard way, but though he did not wish to make an opportunity to take credit for it, much of his own work had been done in the evenings after a day's work. The part-time teacher had a tiring job, but there was an expansion in the part-time day release arrangements which enabled the student to begin his academic period fresh and clean. Nevertheless the fact must be faced that many of the best students came up through the evening courses, and he had not as yet been able to clarify in his own mind whether attendance outside working hours should or should not be abolished entirely.

Lectures arranged by firms were a good supplement to the main courses in the college, but they could not replace the latter. Such schemes were, however, of very great value.

PROFESSOR IMMER said that the Graduate Engineering Courses at the Minnesota Institute of Technology were conducted with individual companies. As part of his course a student was required to complete a project at a local factory, office, hospital or some type of business activity. This applied to fourth-year college students, both engineers and non-engineers. Some of his own students—girls with no engineering background at all, had gone into a firm manufacturing ventilators and had been able, with the assistance of engineers on the job, to prepare a very creditable project for a product which was about to be mass-produced, though they had no detailed knowledge of engineering techniques. This had involved a considerable amount of work and detailed knowledge on the part of the Instructor at Minnesota University, as well as the co-operation of the company. Case work of that kind meant that companies must be willing to open their books and at least a segment of the company for examination by prospective students.

A member said he did not see how apprentices and students were to be encouraged to take the Higher National Certificate in Production Engineering when that for Mechanical Engineering seemed to be far more universal. He had just completed the ordinary National Certificate Course, and it seemed to him that it would stand him in far greater stead to take Higher National Mechanicals. This would appear to open a far wider field.

MR. WORTH said he appreciated the fact that by long tradition there was a feeling that one offered more advantages than the other. However, in his experience the Higher National Certificate in Production Engineering had carried with it in the past considerable exemption from the examinations of the other Institutions, and with the new examination there might be a rise, even a rapid rise, in status. The problem was a complicated one and depended on the object of taking the course. The young engineer wished to qualify fairly quickly and wanted his qualifications to give him not only professional standing but some of the material things of life.

Equality of status was a question only time could remedy. They must not start out, however, with the idea that Production Engineering was something less than any other type of engineering. Such an attitude was strongly to be deprecated and he would discourage it whenever the opportunity offered. The fact that there had been some disparagement in certain quarters of Production Engineering Courses did not mean that they were necessarily of a lower standard than other courses. He personally would do everything in his power to see that their standard was even higher, since the demand they made was in some respects even greater than that made by other courses.

MR. F. H. PERKINS said that several matters came uppermost to his mind. The first related to a balanced approach. It would be unfortunate if anyone left the meeting with the idea that alternative approaches had been under discussion. The very magnitude of the problem called for a balanced approach by the Institution.

Universities, technical colleges and industry all had their contributions to make. By recruiting men from the Universities, but with appropriate initial training, industry could perhaps make a more effective contribution to the production side than it had done in the past. On the other hand, Mr. Worth had rightly drawn attention to the major contribution of the technical colleges in training part-time students. Again, the college was not alone. It was a partner and did its job of training in conjunction with industry, nor would anyone subscribe, he thought, to the idea that industry alone could develop in a man analytical faculties and thinking ability comparable with the best in the country. The colleges and industry must surely make a combined effort; and those in industry who were devoting great attention to practical training must act in conjunction with the more theoretical training provided in the colleges.

On the question of management and management training, a definition was required, and he had found none better than that it was something which concerned all who had the job of controlling other people. That applied to all, from the lowest level of responsibility right up to the top, and men who were training more particularly on the production side and aspired to seniority in their own firms were probably becoming more and more associated with the managerial function. It was therefore right that in the more advanced stages more attention should be given to that side as far as it could be dealt with in college courses. It would, however, be dangerous to suppose that the last word could be said on management in any course. One of the points stressed by the Urwick Committee, of which he had been a member, was that this subject could only be developed from the college side in close liaison with advancing experience in industry and responsibility in industry.

Care should therefore be taken that courses in management at the culmination and termination of the more technological courses were ever more closely allied to increasing responsibility in industry.

MR. SMITH said he fully agreed with what Mr. Worth had said with regard to day release. As a day technical college student he thought it important that the right type of student should go into the right course. Unfortunately, a student might go into civil engineering, or mechanical engineering, or electricals but then find it very difficult to get into a Production Engineering Course. Probably the Institution was to blame for coming under the cloak of the mechanical engineers. As an Institution of Production Engineers it should perhaps expand on the horizontal plane rather than as with the mechanicals and electricals on a vertical plane. This was a very sore point throughout the country, but it was difficult to overcome.

As regards post-certificate lectures, no one had as yet pointed out that Institution lectures formed a very valuable method of education. Up and down the country, some very excellent lectures were given by very able people.

Mr. Worth had said that an average of ten students took the Higher National Certificate, which meant an influx of over 150 students per year going through a five-year course. This was about the average for the majority of technical colleges—the remainder fell by the wayside.

As regards case study, unfortunately classes were only allowed 60 hours in the year, approximately, and time was difficult to find.

MR. WORTH said he had no criticism to offer here but would repeat that the technical institutions had immense educational possibilities.

With regard to the statistics, it must be remembered that the qualification for entering a Higher National Course was an Ordinary National Certificate with technology content. The 150 students would therefore not, perhaps, enter directly into a Production Engineering Course but into a general engineering course, which rather altered the statistical aspect of the problem.

THE CHAIRMAN called on Mr. B. H. Dyson to propose a vote of thanks to Mr. Worth and to Professor Immer, who had so ably supported him.

MR. DYSON said some of those present might have come to the meeting wondering whether education in production meant anything at all, but when they saw Mr. Worth using the common umbrella as a pointer with such confidence and realised that he was a Production Engineer, they must have realised that education did something ! Also, the common and harmless umbrella could

be used as a tool for assault or a tool for defence ; and possibly one lesson they had learned was that educational training, even as the background of an engineer, was well worth while.

It was a tribute to Mr. Worth that he had not tried to blind them with science.

His own problem was, at what stage and what age should one go from technical, practical training to managerial training? If they were not careful they might fall into the trap of training too many consultants—or too many people who wanted to consult—and get too many " insulting " engineers rather than men willing to do the actual job. In his experience there was no shortage in industry of men with ideas. But there was a big shortage of men who could make ideas work—someone else's ideas as well as their own. That was one of the gaps the technical colleges could fill.

Possibly that was one of the advantages enjoyed by the American colleges. They set out to educate a man to earn a living and do a job of work, and not to give education for education's sake. On the other hand, the meeting had shown that the Institution would get just what it expected ; and they had to ask themselves, what was their standard of expectancy? What did they expect a Production Engineer to be? When they had really made up their minds what they wanted, they had to do something in order to get it and not leave it to educationalists. The Institution had shown a lead in the right direction by appointing Mr. Worth—a very worthwhile individual—to set the pace. All they asked was that the Institution would give him full, ample and energetic support. He had great pleasure in welcoming Mr. Worth on what was probably his first visit to the London Section after his appointment, and promising all the support the London Section could give him. That must not be just lip service. All of them, through the technical colleges, the Institution, and their own businesses, must see that something was achieved. On their behalf, he thanked Mr. Worth very much indeed.

Mr. F. H. Perkins said he had great pleasure in seconding the vote of thanks. He took the opportunity also to reinforce Mr. Dyson's suggestion that the answer to the problem lay with themselves. Mr. Worth had given some indication of the progress that had been made, but there must be further progress. The diagrams were very good to look at but the actual absolute values were small, and most of the blame for that might be assigned to industry rather than to educational institutions. The colleges provided a broad avenue for the development of the Production Engineer and a great deal could be done, by strengthening their courses, by establishing post-graduate courses at Universities, to improve the position further, as was shown by the success already achieved.

The CHAIRMAN said he too would like to thank all those who had made such an able contribution to the discussion.

DERBY SUB-SECTION

A member asked if it would be possible before the time of the Production Engineering Course, for an endeavour to be made to prove by an industrial intelligence test or other means that the Production Engineer had a natural contribution to make in this field.

His second point, also touching on economics, was the cost of educating the engineer who eventually made the grade. He felt that education formed an appreciable portion of the rates and cost to industrial establishments, and for industrialists this was a very high cost, the trend appearing to be for apprentices to spend more and more time out of the department. He had seen a scheme whereby apprentices spent only 38 per cent. of their time in their own departments and he asked whether this was disproportionate.

MR. WORTH replied that aptitude tests for the selection of personnel taking these courses were very important. He felt, on the other hand, that there was still a great deal to be done concerning the application of these tests. Anyone could apply them, but many were negative tests and the interpretation of the results was not easy. Institutions such as the Tavistock Institute of Human Relations and the Institute of Industrial Psychology were doing first class research work which would give positive results.

Commenting on the point at which technical education for Production Engineering was commenced, Mr. Worth said that was by the age of approximately 19 years. The student started at 16 years by taking an ordinary course in the general sciences, leading to the Ordinary National Certificate in Mechanical Engineering. Only then did he begin to specialise in specific Production Engineering subjects. There was bound to be a considerable wastage, possibly due to bad selection.

The scheme whereby an apprentice spent only 38 per cent. of his time in his particular works section appeared to be unbalanced.

With regard to the courses as at present, a second member had experienced very great difficulty due to students lacking practical ability or practical experience. He felt very strongly that there were a certain number of students who unfortunately went straight into the Drawing Office, and were trained as Production Engineers without the fundamental practical experience. He asked if it would be possible to deal with this problem in the Courses.

He also wished to see Management in industry giving more scope to students to become better acquainted with their own works. There were very many instances, he said, where students did not

know what was going on in their own works, outside their own particular department. He asked if the aid of management could be sought in this respect.

MR. WORTH, in replying to the last point, said there were developments in that field among some firms, who were instituting apprenticeship schemes in which the apprentices were taken, not only from department to department, but were given what might be termed "initiation training," during which they attended lectures by the firm's specialist staff, to give them an overall picture of the products, the markets, customers, and so on. There was also recommendation by Government Departments concerning the use of works' information which flowed not only from the Management downwards, but from the apprentices up to the Management. These were developments which were just beginning, but Mr. Worth felt it was not possible to do too much to obtain the apprentices' or the students' interest in the work as a whole.

Referring to the first point, concerning the lack of practical training, Mr. Worth did not think this could be introduced into the courses; that was industry's job. The ideal linkage was industry plus Technical College, the Technical College performing its true function of technical education—and providing opportunities for experiment and investigation—as distinct from the acquisition of skill. A scheme had been proposed whereby lecturers in Colleges should be able to move from the Colleges to industries for the purpose of linking up even more closely, but an increased supply of lecturers in Production Engineering would have to be implemented in the future for this to be done. He did not think the lack of practical training could be made good inside the College, that was industry's contribution to the overall pattern of education and training.

With regard to "work measurement"—Mr. Worth had mentioned a specific date, 1950, when the new scheme would come into operation—a question was put whether the new scheme would be applied throughout all Colleges operating the present production scheme, or whether it was just a paper scheme for the time being. The member wished to know just how deeply this would be studied in future courses.

Replying, MR. WORTH said that from the students' point of view up to 1950, all students who satisfied present educational requirements of the Institution and who applied or were elected as Graduates, would be deemed to have satisfied all the educational requirements and would not be asked to take any or part of further examinations. After 1950, the question of exemptions would arise. This question was being studied at the moment and exemptions would be granted on a subject-for-subject basis.

The member said he was interested in studying the subject and if

there was any possibility of further study. The district itself was short of lecturers on that subject and courses, and after 1950 he would be interested himself, and he wished to know, if the scheme did not cover the Derby district, if there would be any possibility of studying the subject through the Institution.

MR. WORTH replied that where "Work Measurement" was not applied to any great extent or where the facilities were scarce, there should be no reason why interchange of personnel should not take place, or interchange of students, and he would like to see that encouraged.

MR. HIGGINS, in moving a vote of thanks to the Education Officer for the evening's lecture, said that the subject of Production Engineering and Education was one very dear to him, and he had been particularly gratified to know that Mr. Worth did not put forward the new scheme as the only method of approach and claim it as ideal. Personally, Mr. Higgins would have liked to have seen a much stronger scheme than the one envisaged.

On behalf of those present he thanked Mr. Worth for his assistance and said he was sure the Institution had done a very wise thing in maintaining the standard of the good work previously done. The Institution and Mr. Worth were to be congratulated.

In conclusion, Mr. Worth thanked Mr. Higgins for his appreciation and said how much he had enjoyed the opportunity of addressing the Derby Sub-Section. He was conscious of the inadequacy with which he had dealt with a very wide subject. There was one final point he wished to stress, and that was that as the Institution's Education Officer his services were at the disposal of the members, and he would be only too pleased to give all the advice and help he could on any problems which might arise.

GLASGOW SECTION

MR. L. BROWN said the lecture on the training of the Production Engineer had been very interesting, but he wished to point out that with all this very necessary training of the Production Engineer, it should not be forgotten that it was the man on the floor of the shop who finally had the ability to make or break a job from the cost point of view. For that reason, Mr. Brown thought there was a great need today for more and more training in the crafts of operating the machine. It was certainly something on the practical side of training which should be developed without going the whole way in technical training. Everybody could not be a Production Engineer, or Production Manager, or a Manager and for that reason he thought it a pity there were no courses which would instil into people the will to work.

Mr. Brown continued that he had noticed in some of the earlier charts one with regard to the Production Engineer in Australia,

where time and motion study was mentioned. As he understood it, in Australia they were not just particularly keen on the incentive bonus system ; by teaching the subject of time and motion study they eventually hoped to have engineering firms operating their own incentive bonus schemes. Mr. Brown asked if Mr. Worth had any information on that at all.

MR. WORTH replied that in regard to the first point raised by Mr. Brown there was no doubt about the need for consideration of craft training. He had had long talks with the various gentlemen he had met during his visit and with other people in England, and there was a great awareness of our lack in that respect ; it was realised that it depends upon the man on the job. For a long time the craftsman had been despised and had not received due reward for his effort. The transference of the skill from the man to the machine may have been the cause of that, but on the other hand there was without doubt a real dearth of first-class craftsmen and awareness of this was evidenced by the deliberations of the Regional Councils. Mr. Worth said there were ten such Councils for England ; he thought there was a number to be set up for Scotland, and he explained that these Regional Councils were giving serious consideration to a form of National Apprenticeship, which involved the principles of craft training, with a sufficiency of engineering science and maybe workshop calculations to enable the appreciation of machine craft.

With regard to instilling the will to work, Mr. Worth did not know whether that could ever be done. The larger problem of mental outlook came into it and it was not one which he would like to deal with at length without considerable thought. It had been said that there was no will to work in certain instances, but on the other hand output had been increased, sometimes by about 200 per cent., with an overall productivity represented by 15 per cent. That seemed to indicate the introduction of new methods, but he felt that new methods did not apply wholly, he was sure the will to work was there. Mr. Worth was not sure whether this subject was one for generalisation, but it was one on which a discussion might be held.

With regard to Australia, Mr. Worth continued, there was no subject such as Time and Motion Study in the courses ; the syllabus itself led up to the early consideration of motion economy. He felt care should be exercised in all educational schemes to differentiate between motion studies and time studies. These had been associated in the past with industrial hostility and very often the trouble had been due to the application of time studies. They were not automatically linked up by motion economy, which was a study to enable the job to be done the easiest possible way without respect to financial gain or loss.

MR. TIMBURY stated that with regard to Trade Classes, or Craft Classes for the young engineer, he would like to place on record the good work being done by the Corporation of Glasgow at Stowe College. He thought if the lads were well chosen and sent to Stowe College, it had the great advantage of giving them an entirely new outlook on craft training. If progress was satisfactory, they would end by being draughtsmen, and perhaps executives.

He asked Mr. Worth to give the meeting some idea of his opinion on the value of classes within the works for young selected engineers. He asked if these works' classes were of any value, or if their value compared with the work of the Technical College. He did not suggest that these classes should take the place of the Technical College.

Mr. Timbury was glad that Mr. Worth had laid stress on the personal side of Production Engineering. In Mr. Timbury's opinion the personality of the Production Engineer was a matter of very grave importance, and he was very glad it had been emphasised.

MR. WORTH, dealing first with the point concerning the classes within the works, said he felt they did perform a very useful function, and that in the introducing of the young entrant into engineering, very much good could be done by letting him partake of such classes and closely watching his reactions to the various trades and lectures for perhaps a period of three or four months, with a view to seeing whether he had any real leaning in one particular direction. He had heard that many firms were doing this. A certain amount of good could be done by giving the entrant an overall picture of the works' activities. Mr. Worth agreed that the Works' School did not, and was not intended to, replace formal technical education, but it gave the Apprentice Supervisor, or Personnel Manager, the opportunity of assessing the boy from the works' angle.

Mr. Worth was glad to receive Mr. Timbury's support on the personality side. It was individual reaction which played such an important part, both in work and play.

He felt it would be wrong to comment on the educational pattern of that area, except to say that he felt interested in Stowe College and appreciated the work they were doing. They had made a considerable drive to ensure that they had the qualifications and the staff to carry on the Trade Classes for City and Guild Candidates. He did not know whether Mr. Ferguson of the Scottish Education Department would care to augment his remarks on that point.

MR. J. FERGUSON stated that his Department of the Scottish Education Department had been aware for many years that too much emphasis had been laid on technical education of students on the

design side, with little or no education on the production side and the Department had done all it could in recent years to remedy that. The fault had not been altogether with the Department or the Technical College; there had not been very much pressure from industry in that direction, but, within the last two years, substantial progress had been made. Mr. Ferguson referred to the fine Department which Mr. Stabler had organised in the Technical College, and to the Heriot-Watt College in Edinburgh, which was an approved centre for Higher National Certificates. He stated also that there would soon be another at Dundee, and that when this had been accomplished the Department would have pretty well broken the back of the problem of the type of lad who was suited to the Higher National Certificate in Production Engineering.

At Coatbridge, Mr. Ferguson continued, there was a centre quite well equipped for the Craft Classes. In Glasgow there was the centre at Stowe College Machine Shops which had been improved and were being re-equipped, and there was also the Technical College at Burnbank, near Hamilton, which was also very well equipped. Both these centres would be ideally suited for the training of the craftsman. Mr. Ferguson wished to stress that these places had been equipped in the belief that industry would give support by releasing boys during the day. It was not economical for authorities to set aside special accommodation and equipment for use only in the evenings.

Referring to part-time day work in Scotland, which Mr. Worth had indicated appeared promising, Mr. Ferguson said this was not entirely correct. Mr. Worth had said that at the moment about 6,000 young people had been released from industry; that seemed a satisfactory number, but there were over 200,000 released in England. On a population basis Scotland should have over 30,000 released, and efforts generally in this direction had not been very fruitful. That had applied all along the line in technical education in Scotland and perhaps particularly in the West of Scotland, because the bulk of the industry in that area was the heavy type and there was not so much of the lighter type of industry. With the newer firms, however, Mr. Ferguson stated there was no trouble at all.

Mr. Ferguson next referred to the Conference on Modern Production Technique which had been conducted during the war. This had not been repeated because it had not been well supported. The reason which had been put forward was that people were too busy to attend during the day, and too tired to attend in the evening. In England, however, these conferences had been extraordinarily successful.

In conclusion, Mr. Ferguson mentioned the course in Manage-

ment Study at the Commercial College which took two forms, one of three days a week and the other a full-time course of six months.

MR. J. GALLOWAY dealt with the subject as far as the heavy industry of Clydeside was concerned, where there was a moving population, as compared with the Midlands where the boys, when trained, went on to be something else in the works. Mr. Galloway said he represented one of the largest shipbuilding firms, but only about 4 per cent. of the apprentices were retained. About 80 apprentices every year were trained, of whom about four remained with the Company.

Mr. Galloway said he had been talking to an electrical engineer about a fortnight before and he had been quite surprised to hear that owing to the same problem it had become necessary to revise the whole outlook on apprentices. Originally the apprentices had been graded into three categories, but now they had been lumped into one grade as an incentive to get them. Mr. Galloway felt that it was of great importance and that the outlook on the training of Production Engineers would have to be altered.

He asked how the Production Engineer would be trained, and said the work had been segregated unreasonably and should be a different term altogether. It should be leaders in production rather than Production Engineers, because on the shop floor there were Shop Stewards who said they were Production Engineers. The link between them was the Foreman ; he was the most important Production Engineer. Mr. Galloway felt that if the Foreman and those aiming at higher foremanship could be interested in this type of training, a valuable link in industry would be formed.

MR. WORTH said Mr. Galloway had raised very many points and he felt he could not deal with them all adequately. The first point, however, concerned the intake of 80 apprentices, of whom only four had stayed with the Company. That was a very important point indeed. Mr. Worth assumed that the 76 who had moved out had probably gone to sea ; in that particular industry, and in many of the Clydeside industries, that would apply, and he did not feel that for these people Production Engineer training could offer very much. The solution to that might be, in Mr. Galloway's case, that if 80 apprentices are taken on, 60 would be expected to move at the end of their apprenticeship ; the other 20 would start on the understanding that they had come with no wish to go to sea. There would be fluctuations within that scheme, but that might be a solution by pointing out to the entrants that there would be a certain number of vacancies for people who would move out of the firm and a certain number for those who would be expected to stay.

Leaders in production was an attractive title and Mr. Worth

was interested concerning Mr. Galloway's approval of the idea of granting status to the foreman. He felt that the foreman had been neglected and that it had not been realised that he was one of the main links in production. By setting up courses and giving the foreman due recognition, he could be encouraged in his work.

The drift to the office was important and difficult to explain, and he wondered whether or not this drift to the office and the searching after the white collar job was not the result of unbalanced progress.

Mr. H. N. Henry said the sentiments expressed by Mr. Worth were very much the same as his own. He spoke as an Education Officer and he drew attention to his conception of education. It was simply the acquisition of experience and of written matter. One knew that experience is difficult to acquire, and since education was the acquisition of experience, it meant hard work. That was the difficulty educationalists found amongst the students who went to Colleges and left before the session was halfway through.

Referring to Mr. Worth's remarks on the Industrial Revolution, Mr. Henry said there were two types ; the first Industrial Revolution had been little more than a change in method, or a change in craft, in the fact that tools, new tools, were produced. These tools, he said, were the result usually of manipulative experience. In the present century another industrial change was taking place, which might be termed the Scientific Revolution, and the Production Engineer was the scientific substitute. The Institution was concerned with methods of production certainly, but the lecturer had been concerned with the training of the man who was to direct that production in the best possible way.

Particular reference had been made to Trades Classes. It was true that up in Scotland they had perhaps lagged behind. That arose from the traditional and educational system where the son of a reasonably well-to-do, or better type of working-class family desired to get a collar-and-tie type of job. The explanation was largely psychological ; people wanted security and they felt if they had a collar-and-tie job there was less opportunity of being sacked. Mr. Henry thought that lay at the bottom of the desire for clerical work in preference to manipulative work, but manipulative work brought to mind another thought : he felt the time was coming when there would be better and more complicated tools, tools which would work more accurately, cutting out the necessity for skill in operating the machine, which could be regarded simply as another type of tool.

Mr. J. MacGregor said he had read somewhere in the Production Engineers' literature that an individual either was or was not a Production Engineer. Either there was the ability to be a Production Engineer or there was not, and in Mr. MacGregor's

experience this view had been confirmed. He held an administrative position in a Company employing some 8,000 people, and in that position he had had the job of selecting people for executive positions. He had been rather appalled to find how few B.Sc's., etc., could be placed in executive positions. Very often people with fewer technical qualifications and education had had to be appointed over them, and he thought this brought in the question of leadership, which he had not seen stressed in any of the curricula. There was education on one side, but the application of that education and the ability to apply the principles learned, were surely equally important.

There must be quality in production, as well as just attractiveness, Mr. MacGregor went on, if export markets were to be gained. Attractiveness was not sufficient.

He would like to make one more remark on this point about indirect works, which had come up at the last meeting. The difference between our productivity and American productivity was somewhere about 400 per cent. If the indirect workers of this country worked 20 per cent. faster to meet this blank they were said to have, that was only 5 per cent. of the total required to meet American productivity, which left 95 per cent. to be achieved by others.

MR. WORTH, replying to the last point first, said he did not recollect having discussed anywhere the problem of whether the indirect worker should work harder. He had only dealt with indirect and direct from the point of view of analyses of training schemes.

The question of attractiveness was very important. Quality was essential ; it was not attractiveness at the expense of quality, but it could not be quality at any cost. It should be quality at reasonable costs.

Leadership, he continued, was not stressed as such, but usually scientific principles applied with leadership could lead to good management. He did not say better, or more efficient, but good, management. The question of leadership had recently received considerable attention and the speeches at the Institution's Conference held at Bournemouth had been mainly on that subject. The idea had been expressed at that time that from industry certain aspects of leadership could be learned, but it was impossible to train for leadership without some ability. By allowing persons to become acquainted with the various management principles, any powers of leadership they had would be far better developed than by just accepting the statement which might, or might not be true, that leaders were born and could not be made.

EDINBURGH SECTION

The CHAIRMAN (Mr. J. L. Bennet, M.I.P.E.) asked Mr. Worth how close the educational scheme of the Institution came to the Training within Industry scheme.

MR. WORTH felt that the two schemes should not in any way be compared. T.W.I. was a training on the job, whereas the courses he had outlined must essentially remain in the sphere of the Technical Colleges. Courses should be backed by educational schemes in industry, which had a very big contribution to make to this problem.

Mr. SAMSON said he would like to make one or two points, the first being with regard to Parts 1 and 2 of the National Certificate. A Higher National Certificate for Mechanical Engineering entitled the holder to exemption from Parts 1 and 2. He did not agree with this, as he did not see how, from the subjects taken in the Higher National for Mechanical Engineering, a student could have a knowledge of the subjects in Part 2 of the Production Engineering Course, because he had never taken them.

The second point was in regard to English. He agreed that in engineering, English as a whole was left very much in the background, and he felt this was a mistake. Far too many people were unable to express themselves properly and to write reports. He thought English and English language should be taken possibly in the first and second years and a great deal of attention should be given to writing reports and to public speaking.

Mr. Samson's third point dealt with Management. He felt that 25 was the very earliest age to start a study of this subject. Students would be well advised to have a look at the Sales side in industry. This would give them an insight into the commercial aspect. A person taking the Management Course at the age of 21 and then entering industry and trying to apply his knowledge would find himself out of his depth. He should first of all meet the practical side.

With regard to evening classes, Mr. Samson thought that an evening course alone as a means to getting the Higher National Certificate should be abolished—one evening and part-time day courses would be better. In an evening course as it stood today, there just was not time for the average student to get through ; a brilliant student could possibly manage it.

Finally, Mr. Samson was very impressed with the Union of South Africa scheme showing a subject, " Mathematics V." Too much time could not be devoted to Mathematics, especially in the Engineering course.

Replying to Mr. Samson's first point, MR. WORTH said that the present examination system would be in force until 1st September, 1950, and a Higher National Certificate for Mechanical Engineering, plus Endorsement in Management subjects, would give exemption from the Graduateship examination. From 1950 the Higher National Certificate in Mechanical Engineering could only give subject-for-subject exemption. The reason was that in the growth of any Institution the examination scheme had to be linked up with

the existing schemes. There was no Higher National Production Engineering Certificate until 1942, and the Graduateship examination remained for 11 years as the only nationally recognised examination in Production Engineering.

With regard to English, Mr. Worth agreed that more attention should be paid to this subject. He had given his first lecture in Birmingham to 120 Higher National Certificate students on "Technical Precis and Report Writing." In that subject some of the fundamental rules of grammar were covered. Words were the raw material of the Report, and the report should be planned as an engineering product, or any other product, for that matter. He had published a paper in the August, 1948, Journal regarding the compilation of technical reports, to enable young engineers to express themselves and present a report planned logically. The title of the paper was "The Planning of Technical Papers and Reports."

Concerning Management and the age at which Management study should be taken, the Institution felt very strongly about this, and as the Urwick Report stated, students should not be admitted at immaturity.

Mr. Worth was very interested in the comment concerning Sales. The Incorporated Sales Managers' Association had recently held a Conference in London at which this problem of Sales and Production had been discussed and it was essential that Production Engineers should have a knowledge of Sales, and that Sales people should realise the problems of Production.

Mr. Worth said he would not like to see evening classes abolished altogether, as he had known them to produce first-class material, but he admitted that it was a hard and long grind to obtain a Higher National entirely in the evenings. He thought the idea of a gradual change was a good one. A sudden change would be bad at the moment, but a gradual change from all evening classes to part-time day classes plus one evening would be a good idea. The evening could be used for discussion or less formal aspects of education.

With regard to Mathematics, this was a very difficult subject to discuss and a difficult question to answer specifically. It depended how, and how far, Mathematics was taught. A knowledge of statistics, graphs and graphical methods was most important.

Mr. A. B. Brown stated that his experience in industry had been wholly concerned with firms completely remote from mass production. He made that comment because some of the remarks he intended to make might appear extremely critical.

With regard to the scheme of education for Production Engineering, he felt that the subjects taught and the approach to those subjects was important. This problem of production engineering

had to be approached from a practical point of view—it was no good having to do things a certain way because that was the rule in the text book.

Referring to the age for Management subjects, he thought that 25 was quite early enough, because after having had a good grounding in technology subjects, the five years between the age of 20 or 21, to 25 or 26 would be very usefully employed in getting a thorough practical grip of industry. He remembered how baffled he himself had felt after having served his apprenticeship and taken his Higher National Certificate, when confronted with some of the methods in actual practice. These had not the remotest connection with what he had been taught in the College. The five or six years between finishing apprenticeship and starting to specialise in Management could be usefully employed by young men in getting to know the practical side from the men on the job.

Mr. Worth had mentioned one point in his lecture about Sections advising and supporting in full the technical colleges. Mr. Brown thought this was a very good thing, and that the various Sections (not to mention the firms in the various districts) could take a great deal more interest in the technical colleges.

He would like Mr. Worth's opinion with regard to correspondence courses. There were many young men who, probably through no fault of their own, were unable during their apprenticeship or in their earlier years to go to a Technical College, and who later on felt they would like to acquire extra knowledge by means of a correspondence course. He hoped that due consideration would be given to them.

Referring to the last point, MR. WORTH replied that any student or young engineer who studied privately or through a correspondence course simply because it was the only method available to him, and who successfully took the Associate Membership Examination, would have satisfied the educational requirements of the Institution. The Higher National Certificate was not the only means of entry, but it would be agreed that it was preferable to study through attendance at an educational institution.

With regard to the Sections advising Technical Colleges, he thought their advice should deal in the first place with demand, and secondly, with content.

There seemed to be agreement between Mr. Brown and Mr. Samson concerning the age at which the study of Management subjects should be commenced and Mr. Worth was very interested to have their views regarding the five or six years from the end of apprenticeship.

With regard to the teaching of Production Engineering, the method of approach was mentioned. That was most important. Concerning text books, there was a very great need in the United

Kingdom for really good Production Engineering text books. He would suggest that anyone who had the ability and the time could contribute in this respect by writing a text book on Production Engineering, keeping the question of approach in mind.

Regarding mass production, Mr. Worth said he took the opportunity to state, very sincerely, that the principles which were taught in the Higher National Course in Production Engineering did not of necessity only relate to mass production. They related to all methods and scales of production, and were truly fundamental.

MR. A. B. BROWN, commenting on Mr. Worth's suggestion that various Production Engineers should write text books, said that one of the reasons for his insistence on the five or six years interim period was made because of that fact. So many really sound production men in industry were men who for one reason or another were unwilling to express themselves on paper ; the same people on the job, and with the job in front of them, could expound, clarify and instil the principles of Production Engineering far better than they could ever do—or anyone could ever do—through the medium of a text book. These men had no paper qualifications beyond apprenticeship, but they had something which they, and only they, could pass on to the young men. He felt that the younger people would be missing a tremendous amount if they did not get the opportunity of meeting, learning and watching the examples that these men could give.

With regard to Mr. Worth's statement that the method of teaching or the subjects taught would not of necessity relate to mass production, Mr. Brown quoted the example of his own firm, which made four main products. Each of these products differed very considerably from its neighbour. That absolutely precluded the formulating or setting up of any pre-planned method of production. If each product was the same as its neighbour, part of the organisation could be planned to cope with that product, but each product was taken entirely on its own merits. He was quite sure that the firm could have some ordinary form of production layout. How were they going to apply the principles ? He had not found any text book or any scheme of Production Engineering which gave the answers. He felt that because so many, not only in the United Kingdom, but also in America and possibly in the Dominions, were engaged in that type of production, the need for principles of mass production control in planning was the teaching and demonstration of the scientific application of the principles.

MR. LEE asked if Mr. Worth thought that Management could be taught. If so, the speaker disagreed with Mr. Brown and Mr. Samson, and suggested that if the principles of Management could be taught, they could be assimilated at an earlier age. He would like to draw an analogy from his own experience. He had served

his apprenticeship on internal combustion engines and had been taught very thoroughly the theory of internal combustion engines in all its forms long before he could ever assemble an engine. Would it not be right, therefore, to say that the principles of Management could be assimilated and taught some time before they were put into practice?

He believed that there was a technique of learning which was acquired by students attending classes in Technical Colleges. With practice, they became expert at assimilating knowledge. He had noticed that the Urwick Report suggested that Management subjects might be taught at 18, which was possibly a little young, but since the technology training would be completed before 25, or ought to be, there would be a hiatus between the study of the technical side and the study of Management. This was most unfortunate, because he thought that students would find that the tools of learning had become rusty. He strongly urged that the learning of Management technique should not be postponed.

MR. WORTH thought that the question of the gap between the study of technology and management subjects, and the forgetting of the principles of learning and the power to learn, were not so important when the method of teaching Management subjects was considered. The method of teaching was largely a question of scientific approach to Management, the principles of which were not necessarily mathematical; they were principles of behaviour. Another method of study—that of discussion and definition of the type of action that might be taken in certain circumstances—developed a method of approach rather than imparting factual knowledge.

Management in its ultimate function could not be taught except by experience. Scientific approach could be taught, but he felt that too academic a meaning should not be placed on the word "taught." Anyone who by personality and background had been chosen for Management grade, whether junior or senior, to be associated with a group and to study the history of the scientific approach to Management, was bound eventually to gain knowledge of some of the fundamental principles of Management. That was a very important point. For the answer to "Could Management Be Taught?", he would refer to an article in "Industry" for January, 1949, on that subject.

MR. LEE pointed out that the student, having had his nose to the grindstone for many years up to the age of 21 or 22, was then becoming mature, and in the next few years would probably undertake the responsibilities of family life. He would then find it extremely difficult to continue his studies.

MR. WORTH agreed that responsibilities accumulated with maturity. At 25 one might have responsibilities which made

study extremely difficult. On the other hand, those responsibilities might act as a spur to further study. He felt that the scheme which he advocated would take that into account.

MR. BARRELL wondered why there were so few entrants for Production Engineering examinations. Was it because the Institution was trying to become too academic? The reward in other spheres for academic qualifications was very great, but he did not think that was the case in Production Engineering. Much good could be done in industry as a whole if the efforts of the Institution were directed at educating Higher Management and Directors in Production Engineering, so that they would know the worth of it.

MR. WORTH said it was up to industry first to assess its requirements in training junior engineers and then to use the facilities provided, and to have a well-thought-out promotion scheme. He hesitated to comment on the suggestion to educate Higher Management in Production Engineering, because he felt it was rather too general a statement for comment.

The Institution was hoping to publish shortly a brochure called "Production Engineering." It dealt with the history and activities and careers of Production Engineers, and the importance of the Production Engineer to national economy, and showed how all practical training schemes for Production Engineers could be analysed with a view to content.

MR. BARRELL asked for Mr. Worth's ideas on the value of oral examination against a written paper.

MR. WORTH replied that the subject of examination as a whole was a very complex one, but he thought the oral examination had a definite value, and of course it had been part of the Degree examination of University courses for many years. He felt that oral examinations gave an opportunity to the student of saying the things which he could not put down on paper! It also gave the examiner an opportunity of assessing the student as an individual.

The proceedings terminated with a vote of thanks to Mr. Worth.

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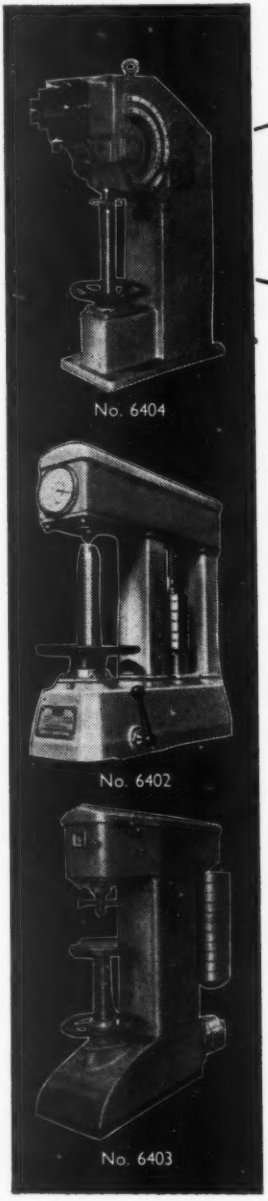

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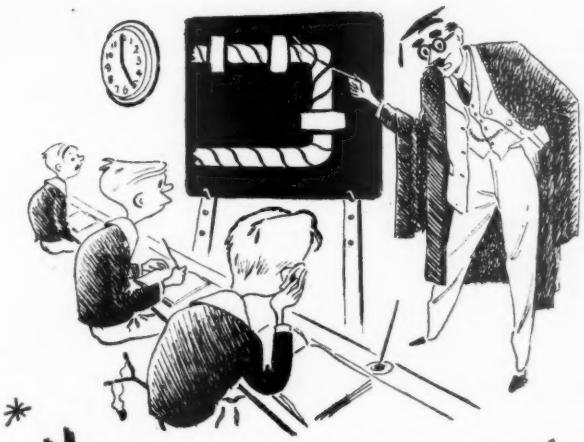

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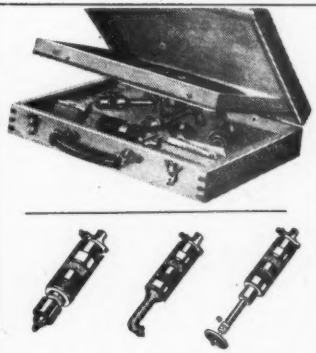

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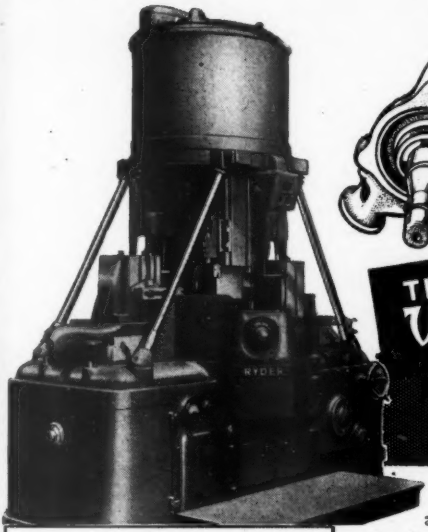

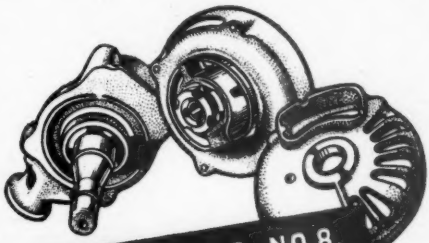

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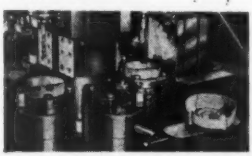

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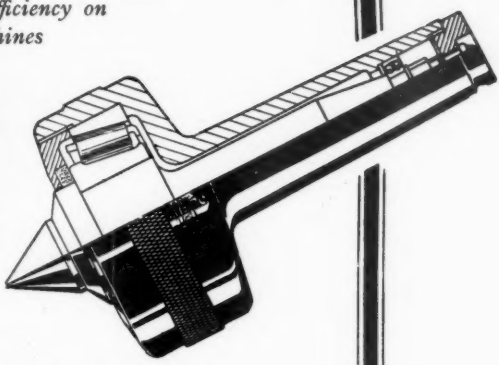

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